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Global biodiversity

An International Forum on the Variety of Life on Earth...
research, conservation and wise use

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Editor's Notebook

I am pleased to announce the beginning of a new column called Eco-services. Much of the discussion about the value of biodiversity has concentrated on the direct economic returns. This narrow view ignores the regional and global significance of the ecological services that biodiversity provides. These services, such as pollinaton, maintenance of oxygen levels, and recycling of nutrients in the soil—to name only a few, sustain conditions for other forms of life. Eco-Services will describe these vital and sophisticated services that biodiversity gives to the Earth and all her inhabitants. Pollination is the first eco-service to be discussed, and the article begins on page 15. *Water cycle moderation -- Natural control of flooding* will appear in the Winter issue.

Don E. McAllister

Don E. McAllister
Editor-in-Chief

The goals of Global biodiversity are to:

- *Publish articles, views and news on biodiversity*
- *Bridge the gaps between professional disciplines & the public*
- *Communicate information on Canadian & world biodiversity*
- *Express views on the needs & value of biodiversity research*
- *Enhance awareness of the role of biosystematic research & museum collections to conservation & wise use of biodiversity*
- *Discuss methods and philosophy of biodiversity conservation*
- *Review books and major articles on biodiversity*

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Cover image is a Common Caiman, representing Venezuelan biodiversity.

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Biodiversity of Terrestrial vertebrates* in Northern Venezuela

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INTRODUCTION

Venezuela is situated in northern South America within the neotropical realm, bordered by the Caribbean Sea to the north and by Colombia and Brazil to the west and south. It comprises a territory of about 916,000 square kilometres (km²) and a population of nearly 18 million inhabitants. For historical and economic reasons nearly 23% of the population is concentrated in the Capital region, which encompasses the Federal District and Miranda State. This north-central, coastal-range area comprises 1.1% of the total area of Venezuela.

The wildlife of Venezuela is particularly rich, totalling around 2,040 species of terrestrial vertebrates. This species diversity is surpassed in the neotropical region only by Brazil, Colombia, Perú, Ecuador, and Mexico. However, rapid changes in land use are seriously threatening wildlife survival in north-central Venezuela. Urban growth, agricultural and cattle-raising activities, mining, and road and dam constructions are all responsible for habitat disturbance and destruction.

In this paper, I report on the composition and diversity of terrestrial vertebrates of the Barlovento region and the threats to their survival.

STUDY AREA

Barlovento is located about 100 km east of the city of Caracas (9°55'-10°40'N, 66°25'-66°35'W) and covers 4,650 km². This area is divided into two major habitat types, interior and coastal. Rainfall is seasonal with a nine-month wet season from May to January and a three-month dry season from February to April. In the interior the mean annual temperature varies between 25 to 28°C, and the total yearly rainfall is between 1,800 to 2,400 millimetres (mm). Along the coastal range, the mean temperature is 26°C and the average rainfall is 898 mm. In the interior the main vegetation types of the region are tropical humid forest and premontane (or below-the-tree-line) humid forest, and one finds mangrove forest and tropical dry forest along the coast.

COMPOSITION AND DIVERSITY OF THE TERRESTRIAL VERTEBRATE FAUNAS

A high species diversity of terrestrial vertebrates is found within the borders of the Barlovento region, inhabiting several habitat types. The number of species recorded so far is around 518, distributed among mammals (122 species), birds (312), reptiles (66), and amphibians(18). Barlovento mammals represent 38% of the total number of the 316 mammals recorded for Venezuela. The majority of mammals are either bats (67 species), rodents (23 species), carnivores (10 species), or marsupials (7 species). Opposums (didelphid marsupials) and small rodent species are the most abundant groups. In addition, they may play an important role as seed dispersers and as reservoirs of significant tropical forest diseases, such as leishmaniasis and trypanosomiasis. The species diversity of big mammals is low in comparison with North American localities. Among the eight species of big mammals listed for Barlovento, four are rare,

*Terrestrial vertebrates are land animals with backbones.

except in Guatopo National Park: the giant ant eater (*Myrmecophaga tridactyla*), jaguar (*Leo onca*), and tapir (*Tapirus terrestris*) as well as one species of spider monkey (*Ateles belzebuth*).

Twenty-four per cent of the 1,296 species of birds reported for Venezuela dwell in Barlovento environments. Of the 59 avian families recorded in the region, 39 are non-passerine and 20, passerine (or perching) birds. In terms of number of species, the most important families are tyrant flycatchers (Tyrannidae, 39 species); tanagers (Thraupidae, 22); hummingbirds (Trochilidae, 22); hawks and eagles (Accipitridae, 20); finches (Fringillidae, 15); New World warblers (Parulidae, 12); ant birds (Formicariidae, 12); blackbirds (Icteridae, 11); and parrots (Psittacidae, 10). The bulk of the avian families are represented by one to eight species.

The herpetofauna is represented by nearly 10% and 27% respectively of the total number of reptiles (246 species) and amphibians (182 species) reported for Venezuela. Fifteen families of reptiles and five of amphibians have been recorded in Barlovento. The most important families, in terms of species richness, are a snake family (Colubridae, 33 species); gecko lizards (Gekkonidae, 8); a frog family (Leptodactylidae, 8); iguanas (Iguanidae, 5); a lizard family (Teiidae, 5); and toads (Bufonidae, 5). Five species of poisonous snakes—three of the genera *Micrurus* and two of the genera *Bothrops*— and three species of big reptiles—boas (*Boa constrictor*), caymans (*Caiman crocodilus*), and crocodiles (*Crocodylus acutus*)—have been reported for Barlovento. The last mentioned species is considered endangered in Venezuela.

THREATS TO SURVIVAL

Land use is changing in the Barlovento region, and the resulting habitat disturbance and destruction are affecting wildlife survival. Along the coast the construction of tourist and recreational facilities, which are being promoted by the private sector, are reducing and polluting many available wildlife habitats. Thousands of people from the Caracas metropolitan area visit the beaches of Barlovento every weekend, and in 1979 alone, nearly 100 projects for the building of tourist facilities were approved. Eighty-two of these projects were located along the coast, covering nearly ten thousand hectares(ha), and aimed for a population of 400,000 tourists. It is little wonder that the most affected species populations are amphibians, reptiles, and waterfowl.

The spread of agriculture and cattle-raising is another major source of habitat loss or fragmentation. Land area dedicated to agriculture and cattle-raising by 1975 was 54,138 and 26,775 ha, respectively, representing 11.6% and 5.8% of the region's total area. However, since 1981 some governmental agencies such as, the National Institute of Agricultural Affairs (Instituto agrario Nacìonal), have planned to increase the amount of land dedicated to agricultural and cattle-raising activities up to 97,739 and 156,763 ha, respectively, which would represent about 55% of the region's area. By fragmentating and destroying large areas of humid and dry forests, those activities are obviously reducing the extent and quality of the available habitats for wildlife. Large mammals such as tapir, jaguar, and red brocket deer (*Mazama americana*) can be highly affected by habitat fragmentation

Although most of the skin of the Common Caiman (*Caiman crocodilus*) is too heavily ossified to make fine leather, the skin is soft and pliable under the throat and along the flanks. And for this small portion, thousands of caimans are killed. Even though so little is usable, caiman skins, nevertheless, make up three quarters of the international trade in crocodilian hides.

because they need large areas to fulfil their nutritional requirements. Changes in vegetation structure and floristic composition might also affect the abundance and distribution of some bird and mammal species. Fruit-eating birds, such as chachalacas (*Ortalis ruficauda*) and curassows (*Crax daubentoni, Pauxi pauxi*), and fruit-eating mammals, such as monkeys (*Ateles belzebuth, Alouatta seniculus, Cebus nigrivittatus*) and kinkajous (*Potos flavus*), can be affected by the fruit availability and the number of fruit species that are required to fulfil their food requirements. Land fragmentation also impedes movement between habitats for those species that require two or more habitats during their life cycles. Terrestrial birds, such as guans, curassows, tinamous (*Tinamus* spp., *Crypturellus* spp.), and quail-doves (*Geotrygon* spp.), are species that move between habitats.

On the other hand, some species of mammals might benefit from the changes in land use. Squirrels (*Sciurs granatensis*), rabbits (*Sylvilagus brasiliensis*), and red brocket deer procure food and shelter in the cacao plantations. Horticultural fields supply food for peccaries (*Tayassu tajacu*), althought sometimes they are considered a pest by rural people. Mammals of open habitats—primarily, the white-tailed deer (*Odocoileus virginianus*), capybara (*Hydrochoerus hydrochaeris*), and the common fox (*Cerdocyon thous*)—and fruit- and grain-eating birds can take advantage of the secondary vegetation and fruit plants. These animals can now include in their diets fruits (banana, plantain, mango, orange, passion fruit, and watermelon), cereals (corn and beans), and grasses found on grasslands.

The construction of water reservoirs as pools and dams for irrigation of crop fields, cattle raising, and fish culture have increased the available habitats for amphibians, caimans, and waterfowl (grebes, cormorants, herons, egrets, rails, coots, and jacanas).

Although the Great Curassow (*Crax rubra*) and the other 35 large pheasant-like species are ground feeders, they are very agile in their nesting haven in the forest canopy, and are responsible for most of the eerie echoing calls so typical of the jungle.

HUNTING PRESSURE

Hunting in Venezuela is regulated by the Law for the Protection of Wildlife issued in 1970, and the annual regulation of sport hunting. This law classifies hunting for sport, commercial, scientific, or pest control. At Barlovento, wildlife is hunted primarily for food by rural subsistence hunters, which is considered illegal in Venezuela. A small number of urban people partake in sport hunting. According to official game statistics, the total number of game animals taken in Miranda State during the 1981-82 hunting season by hunters coming only from the Federal District and Miranda State itself was 333. This makes 0.5% of the total game harvest (66,748) of Venezuela during that season.

About 65 wildlife species are affected by subsistence hunting. Birds (32 species) and mammals (25) are the most affected, while reptiles (8) are the least affected. Meat and eggs are the main wildlife products used by rural people. Species are also used for medicinal, trading, and ornamental purposes, and some species are maintained as pets. The number of subsistence hunters is currently unknown at Barlovento. Because the population growth rate in the region has been slow and constant between 1950 and 1979, with population numbers ranging from 63,835 to 97,000 inhabitants, it is assumed that the number of hunters is probably constant as well. However, it is unknown how subsistence hunting pressure has affected wildlife population numbers.

CONSERVATION AT BARLOVENTO

The great biodiversity of Barlovento and its proximity to the Caracas metropolitan area make this region a conservation priority for Venezuela. Agriculture, cattle-raising, and the tourist industry are threatening all habitats in Barlovento. Unplanned land use will surely disturb and destroy large tracts of tropical humid and dry forests, and in turn, severely threaten wildlife populations.

At the present time, wildlife is legally protected in several natural reserves that together make up 19.8% of the region's total area. Guatopo and El Avila National Parks, parts of which lie in Barlovento, protect 42,910 and 4,480 ha, respectively, of interior habitat; the Alfredo Jahn Natural Monument (58 ha), Laguna de Tacarigua National Park (19,400 ha), and the protected zone of the Central Coast (26,100 ha) together cover 45,558 ha of coastal range.

In order to preserve Barlovento wildlife, law enforcement should be improved, and additional encouragement, education, and support should be provided. Wildlife conservation and environmental education programs are also urgently needed. Those programs should be addressed to both urban and rural people, and principally, to those who live in or near localities that are being affected by changes in land use and hunting. Governmental and non-governmental organizations, the general public, and tourists, who visit the region on the weekends for recreational purposes, must be informed about the threats to wildlife survival in northern Venezuela. Also, they must be told about the urgency of creating land-use plans that take into account people needs, but at the same time, mitigate the impact on the natural resources.

ACKNOWLEDGMENTS

The Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT Project S1-1158) and the Consejo de Desarrollo Científico y Humanístico of the Universidad Central de Venezuela (several small grants) have partly supported my research on wildlife in northern Venezuela.

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The coati (genus *Nasua*) are confined to South America. Like their raccoon relatives, they are insect and egg eaters and prey regularly on caiman eggs.

How much land is there on Earth? For people? For nature?

Analysis of the size of the burgeoning human population and the fixed area of land on Earth shows that there is only a small area per person, and that area is shrinking. That same area must also accomodate all the other species and their ecological services for the Earth.

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INTRODUCTION

I have thought for a long time if we are to operate the "space ship" Earth, we need some basic operational information: how much space is there for the passengers—human and non-human? How much plant life is needed to supply food, oxygen and carbon banking (to moderate the greenhouse effect), and habitat? We should study and know enough of these details so we will be able to maintain the conditions to sustain life in the "space ship." These were the beginnings of the musings that lead me to write the present article.

Perhaps it is living in and flying over Canada that gave me the impression that there would be several square kilometres or even several dozen square kilometres per person, if you were to divide up the Earth's land area equally amongst the world's population. There are large unpopulated areas of forests, tundra, and prairies in Canada, and relatively, few people. I knew, of course, there were many more populous areas around the globe, but as in Canada, large areas of northern Asia, Africa, and South America appeared to be thinly peopled. My impression was quite wrong.

Because the endpoint of this discussion will be in hectares (ha), the rest of the discussion will be in that unit. For those still using imperial units, there are 2.5 acres per hectare (100 m by 100 m).

HOW MUCH LAND IS THERE?

There are about 14.9 billion ha of land on the planet. Eleven per cent of that area is taken up by permanent ice caps, like those of Antarctica and Greenland, and deserts take up 23% (semi-arid, 13%; hot, 8%; cold or coastal, 2%). Both of these fragile environments support little biodiversity or human activities. So if we subtract these areas, we are left with about 9.9 billion ha of significantly vegetated land.

HOW MANY PEOPLE ARE THERE?

There are approximately 5.5 billion people on Earth. Each year the equivalent of Mexico's present population is added to this total, each decade the equivalent of China's present population. Using median growth projections, there will be 8.2 billion persons on Earth by the year 2025.

HOW MUCH LAND IS THERE FOR PEOPLE AND NATURE?

The present day figures yield 1.8 ha of ice- and desert-free land for each person. That is far from what I had guessed. What threw me off were the densely populated cities of the globe, including those in Canada. Now let us consider how much land each person needs to survive on space ship Earth. Considering food, there are presently 1.5 billion ha used for crops and something over 3 million ha used for grazing. On average then, each human needs 0.8 ha for food. There are 968,400 ha of managed closed forest on the globe (World Resouces, 1992-93). This means that there is about 0.2 ha of managed forest per person. This brings the total human use to 1 ha for farming, ranching, and forestry. That leaves 0.8 ha per capita for other human activities, other terrestrial life forms, and the ecological services that sustain the ecosphere. This is tiny! Because humans use some of that remaining wild hectare for other purposes, people are presently exploiting or disturbing over 60% of the vegetated land area of Earth, moderately or intensively.

WHAT ABOUT THE FUTURE?

If the human population reaches 8.2 billion by the year 2025, then the balance of land use will shift. If we suppose similar per capita land use, and assuming arability, people will then be invading and using an additional 2.7 billion ha of the Earth's semi-wild, vegetated land area. This will leave less than 10% of the vegetated land relatively untouched. But these remaining forests, grasslands, tundra, wet and arid lands are not in the old-fashioned sense just "wastelands," awaiting irrigation or development to serve humans. They are the home of the millions of other species that inhabit this planet with us. Those species are not only just living, they are providing ecological functions or services locally, regionally, and globally. (See the new column on eco-services, beginning in this issue on page 15). Studies of the differences in average productivity, biomass, other inputs and outputs, and biodiversity of farm and grazing land in comparison with the levels in natural forests and grasslands will show impacts on the ecological services that sustain the ecosphere. These services maintain the thin bubbles of the atmosphere, the hydrosphere (marine and fresh waters), the lithosphere (soil and rock), and the biosphere (all living organisms) of our planet.

- *Over half of the vegetated land of the Earth is presently used for farms, grazing and managed forests.*

Further human invasion of remaining wildlands will have a disproportionate effect on their integrity as well as area. Already forests, grasslands, and wetlands are dissected and divided. As the pathways for seasonal migrations are disrupted, or habitat for part of the life cycle is degraded or destroyed, certain species will begin to vanish. If the valley bottom used by a mountain sheep in winter is turned into farmland, if the nursery habitat of a salmon at a river mouth is polluted, or if the wintering rain forest of a songbird is cut down, those species will disappear—even if their main habitats are left intact.

SUMMARY

Simple conservative calculations show that humans are using a significant proportion of the Earth's vegetated land mass, and that within the next three decades, about 80% of the vegetated land area and its biodiversity and ecological services will be impacted by human activities. It is time for international studies on the operation of the space ship Earth to be carried out, with calculations of inputs and outputs of both human and natural processes. At the same time it is evident to me that the crew should consider moderating their numbers!

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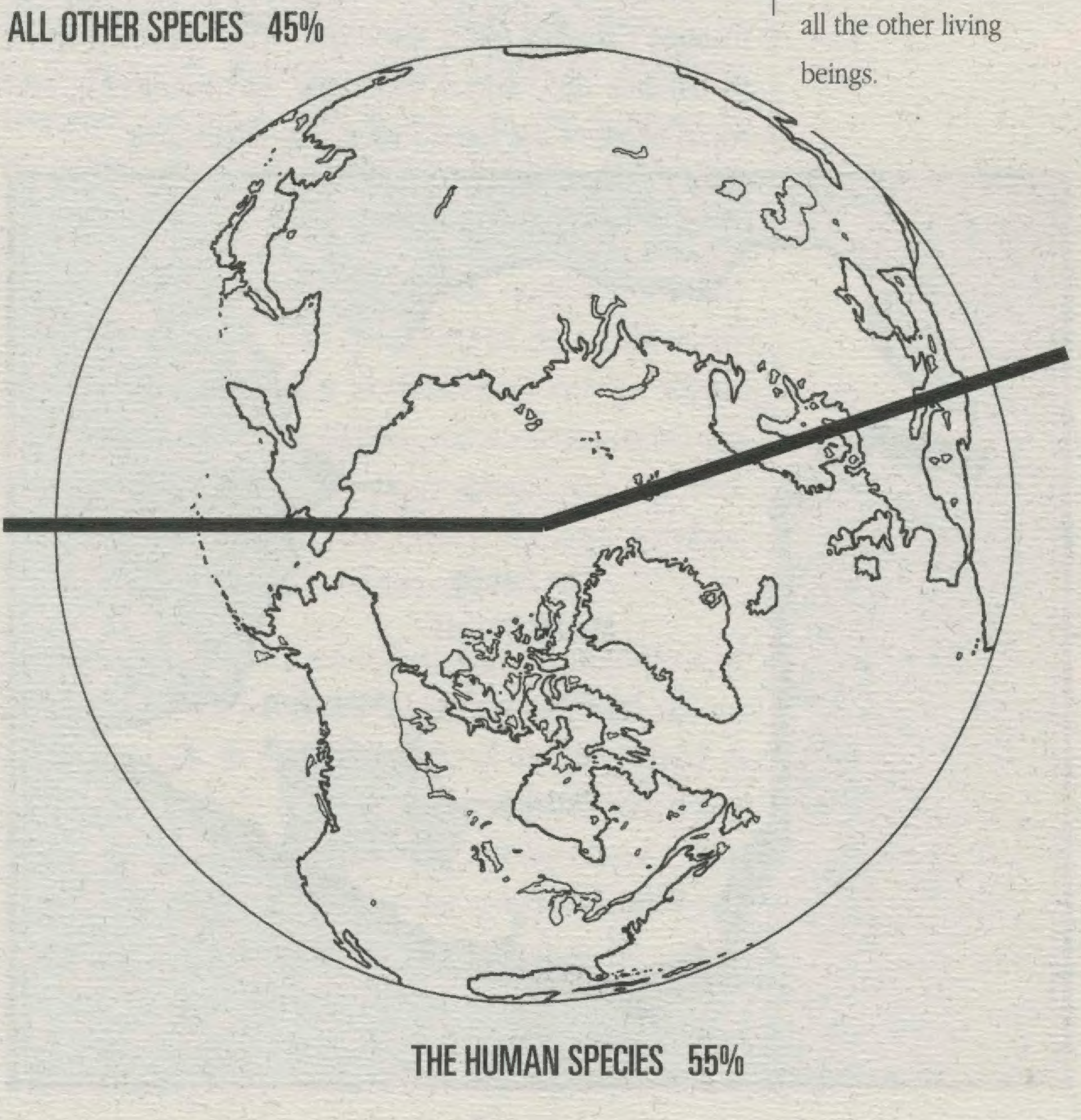
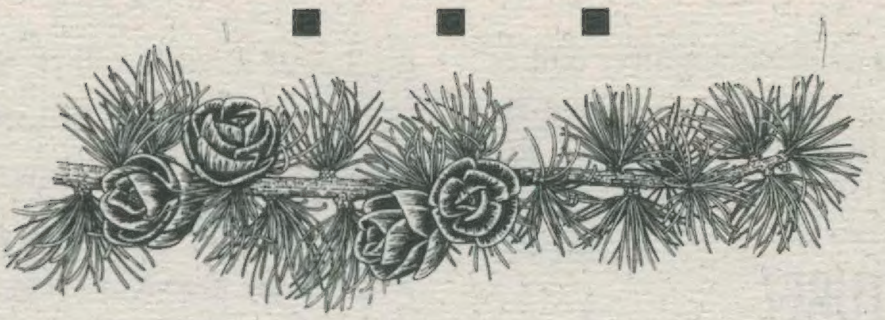


This figure shows the split in global occupation of vegetated areas between humans and all the other living beings.



A sustainable development project:

The Fundy Model Forest

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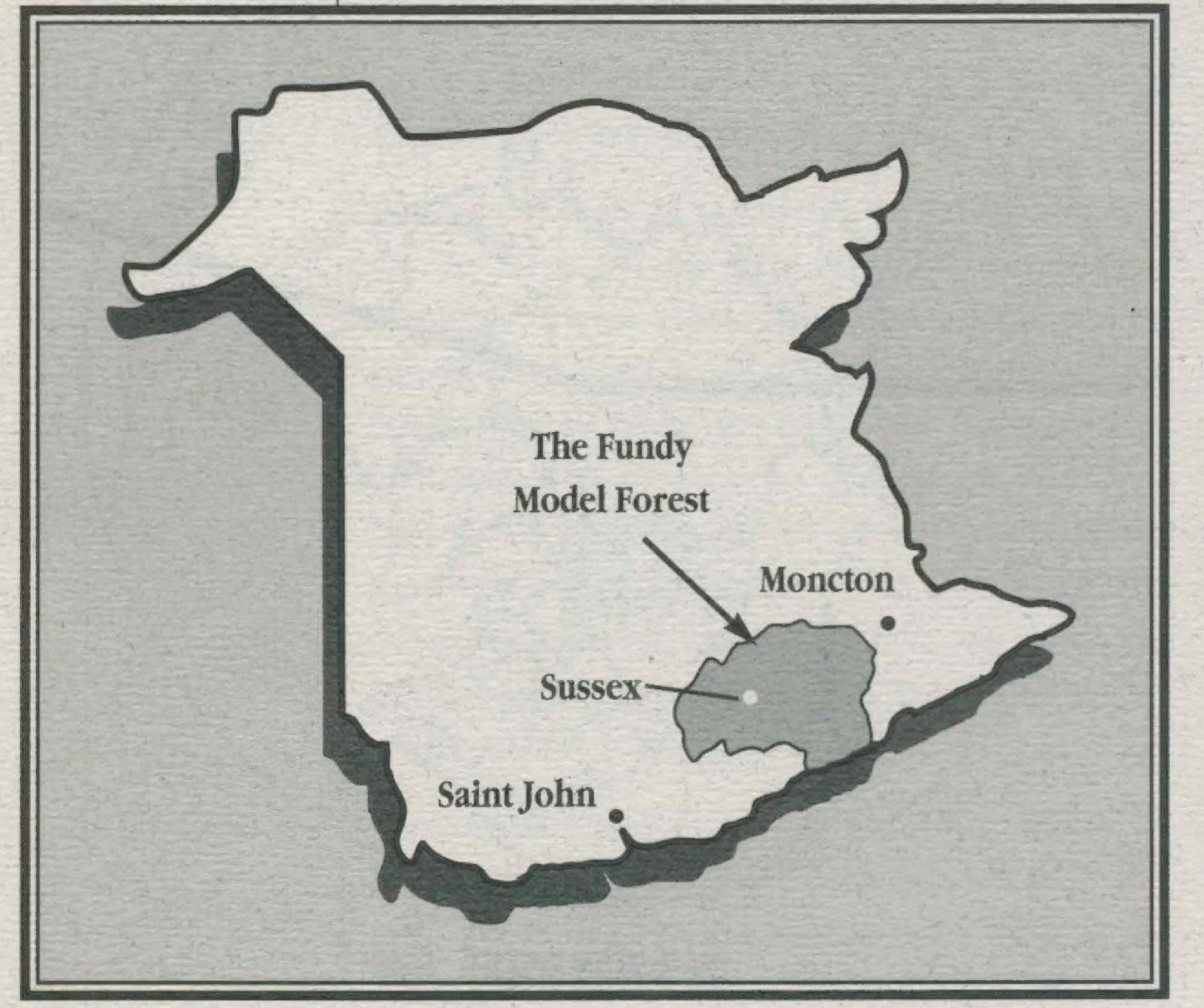
INTRODUCTION

In June 1992 the Fundy Model Forest was selected as one of ten large scale, working models across Canada. Together these sites represent the five major forest ecoregions of Canada. The establishment of this network of Model Forests is an essential component of a federal government program called Partners in Sustainable Development of Forests. The program is designed to support the efforts of Canada's provincial governments and other landowners as they develop new ways to manage Canada's forest resources. This approach seeks to balance the various economic, environmental, and social needs of the forest's users and inhabitants.



The project will be carried out within an integrated operating framework, which is being fleshed out as the project continues. A diverse group of players including provincial environment authorities, a large forestry corporation, a cooperative unit of smaller logging companies, scientists, and the public will work together. Each group has diverse and separate goals, but they share one common challenge: to develop an environmentally focused, integrated, and sustainable management strategy of this particular area. It is hoped that the resulting strategy will be a model for forest management around the world.

The proposed Fundy Model Forest covers 400,000 hectares (ha) of historical territory. Its structure, rich in landscapes, animal habitats, and man-made infrastructures, will be studied over the next five years in order to clearly illustrate the ways in which humans can alter, and yet protect, its inherent biodiversity and at the same time, profit as much as possible from this large tract of land.

LOCATION AND COMPOSITION

Located in the southern part of New Brunswick, the Fundy Model Forest is bordered by the Bay of Fundy to the south, Lake Washedemoak and the Canaan River to the north, the City of Moncton to the east, and the St. John River to the west. The 419,266 ha of Acadian forest includes almost all of Kings County and parts of Albert, Queens, and Westmorland Counties. The City of Sussex sits close to its centre. The area also includes the lower reaches of the St. John River and its tributaries. Several important drainage basins of the area flow into the Petitcodiac and Kennebacasis Rivers.

The southern part of the area is made up of hilly lands and coastal cliffs reaching up 400 m from the water below. Carved out by streams and rivers, deep valleys dot these cliffs. To the north, where the land rises from the river and lake coasts, the landscape is even more hilly; here, the soil is more fertile and forest productivity, better.

Sylviculture (industrial wood production) and agriculture are the cornerstones of the local economy, as revealed by the rural landscape. In many places, forests give way to cultivated fields. The many types of land owners in this area are a challenge to land management, but offer exciting possibilities. Within an overall management strategy of using the forest resources in mutiple ways, a sustainable supply of wood so important to sylviculture should be maintained. This is one of the main goals of this project.

Most forest property (63%) is comprised of small woodlots of 10 to 500 ha. The Southern New Brunswick Wood Producers Cooperative (SNB) represents the owners. In most cases, these woodlots are part of farms; tree cutting either brings in secondary income or represents an important part of a family income in relationship to the income derived from agriculture. Agricultural lands are mostly found along the main rivers, where rich and fertile soil abounds. Many hamlets, villages, cities, and rural communities dot the area.

The largest industrial property in free tenure, covering 17% of the territory, belongs to J.D. Irving Limited. It supplies in part the company's sawmills as well as its pulp-and-paper plants. A reforestation program has been implemented since 1969. The Fundy Model Forest also includes almost 15,000 ha of plantations belonging to different owners.

Almost 15% of the Fundy Model Forest belongs to the Crown; it is included in the Fundy timber licence that guarantees a supply of forest products to 27 local sawmills and pulp-and-paper plants.

The 20,700 ha of Fundy National Park are also included in the model forest and represents 5% of its total area. In accordance with administrative policies, no direct forest management is foreseen within the boundaries of the park. Cooperative studies are planned in order to determine the indirect impact of the forest management practices carried on next door, so to speak, on the park. The results will be used to compare the ecosystem dynamics of the two adjacent properties, which are managed according to differing philosophies.

The resources of the area have been exploited for a long time, and this means access to the Fundy Model Forest is relatively easy. The Trans-Canada Highway bisects the area, and many secondary and rural roads, as well as bush roads, cut across the forest. Private logging roads are well maintained. Access to the scenic coastal paths is, however, quite difficult because of the steep slopes and the rocky outcrops. Within the framework of this proposal, access to interesting coastal tourist areas will be improved.

Over time, the forest resources have been subjected to overharvest and the ravages of insect pests and natural disasters. From a sylvicultural point of view, it is supposed that the genetic quality of today's forest has been eroded by the selective cutting that has gone on for the last two centuries. With better forest management, the diversity of forest stands and the resulting economic diversification are guaranteed.

SOCIAL AND COMMUNITY FACTORS

The forest, which covers the Fundy territory, is unique in the Canadian context: as in many places across Canada, the forest has always represented an important element for the local economy, but here, it has been exploited for more than three centuries.

The Fundy region was first colonized by settlers who came from France and Great Britain after 1700. They survived due to the abundance of natural resources and felled many trees in order to establish their farms. Even in those times, the exploitation of natural resources benefitted the inhabitants; in this way, the economy of the region was built up through forestry, agriculture, naval construction, fishing, trading, and manufacturing.

Massive land clearing for agricultural purposes occurred near the end of the 19th century. The rest of the forest was exploited mainly for sawtimber in order to supply the needs of the early settlers, naval construction, and wood exports. Softwood (mainly spruce) was exported; hardwood was used to heat homes, for farm activities, and for making tools and equipment.

At that time, the forest industry was comprised of sawmills either scattered along small rivers (often measuring only 40 miles in length) or standing sentry at their mouth. These rivers were the Pollet, Goose, Point Wolfe, Goose Creek, Millstream, Kennebacasis, and Canaan. In 1788, Major Studholm stated in his writings that a few of his dams had been swept away by a flood and that he had lost some wood on the Kennebacasis. Use of the forest to produce dimension lumber, boards, and shingles continued until the 1950s when pulp from softwood became an important raw material.

Since the end of the 19th century, the forest area has increased. Agricultural lands from a hundred years ago are now covered with forest that encroaches on private lands. In fact, one can frequently find old cemetaries and piles of field stones along the edge of the forest. These are a silent witness to our rich and varied historical heritage.

Almost 35,000 persons live in the area covered by the Model Forest. In fact, it is estimated that half the population of New Brunswick lives within a one-hour drive from the Model Forest. Although the recent opening of two potash mines has stabilized the local economy, many inhabitants of the region depend on their woodlots to supplement their income or for their primary income.

Two main factors dominate the social changes that will force the reconsideration of forest management within the near future, especially for the forests located near large urban centers. The first factor is the indisputable fact that the population and the present use of resources have both reached their potential—any change would bring about a degradation of the ecosystems. The population is pushing for the creation of a larger number of forest reserves even though the future potentials for production under a new system of management are still not understood.

Table 1. Types of stands in the proposed Fundy Model Forest.

TYPE	AREA (ha)	% TOTAL
Non-forest and unproductive lands	41,608	10%
Agricultural lands	42,316	10%
Softwood forests	96,233	23%
Composite forests	88,028	21%
Hardwood forests	105,605	25%
Plantations	14,836	4%
Logging zone	9,940	2%
Fundy National Park	20,700	5%
Total area of Fundy Model Forest	**419,266**	**100%**

The second factor is the growing demand for products and services. In addition to the traditional forestry products (wood, water, wildlife, recreation), society now gives more importance to the forest as a whole: the forest's biological diversity, its role in the regulation of climatic changes, and its conservation. These are additional "use" factors that may be used in the context of future forest management. However, our challenge will be to balance the very special demands made on the forest with the objectives that we have set for ourselves concerning the supply of sustainable forestry products. It is a well known fact that the solutions we will come to, inherent to this question, and in the context of the Model Forest, will have repercussions on the global scale.

Fundy National Park has an important impact on the social life and economic context of the region due to its importance as a tourist attraction. Each year, the park also allows more than 180,000 visitors to better know and understand the ecosystems and the organisms that live in them. It is hoped that park personnel will develop educational programs that allow visitors to live different experiences in a forest that is actively managed as well as "preserved."

FOREST BIODIVERSITY

The model forest is made up of conifers (29%), mainly spruce and fir, and deciduous trees (27%); the rest (23%) is a composite forest. Almost 20% of the area is made up of non-forest land. Table 1 is a description of the make-up of the proposed Fundy Model Forest.

The area covered by the Fundy Model Forest straddles two forest regions, the Harvey-Harcourt region and the Fundy region. The first one is the largest and most diversified in New Brunswick. It is located in Climatic Zone 2; rainfall, therefore, is not evenly distributed and coarse-grained soils can show a water deficit during the growing season.

A relatively high number of tree species are found in the Harvey-Harcourt region. Conifers almost completely cover the center of the slopes and the valley floors. Vast stands of jack pine are found in the eastern part. A few yellow birch, American beech, and white ash grow on the upper slopes. Red oak and black cherry seek out fertile soils, while white spruce has taken advantage of the many abandoned farmlands. Black spruce and eastern larch grow in the wetlands and the marshes of the lowlands.

The Fundy region is a strip of narrow lands close to the Bay of Fundy, which influences the region's climate, placing it into Climatic Zone 1. Most of the region lies at low altitudes, except for a strip of highlands extending from the mouth of the St. John River to the mouth of the Petitcodiac River. Soils are mainly made up of humus and sandy loam in the highlands; elsewhere, the omnipresent rocky subsoil is covered with coarse-grained and stony soils. Farther down, white spruce, red spruce and balsam fir make up the forest. Yellow birch and balsam, fir grow on gentle slopes and highland plateaux. In bygone days, most of the highlands were cultivated; since then, they too have been invaded by stands of white spruce, red spruce, and balsam fir. The forest has been subjected to many other agressions: the north and east shores of the Kennebacasis River have been razed by forest fires; certain parts have also been decimated by the spruce budworm, the white pine blister rust, and the balsam wooly aphid; and white pine withering is very common in this area.

The Fundy Model Forest is a unique opportunity because of the existing plantations and its past history of forest management. At the present time, the area covered by the model forest is made up of more than 9,000 ha of young plantations (1-5 years) and about 5,500 ha of older plantations (6-22 years). Natural regeneration has taken place over more than 6,000 ha in the last decade.

The total volume of marketable wood adds up to almost 26 x 106 m^3 (excluding Fundy National Park), of which 52% is made up of softwood. Figure 1 illustrates the percentage of the area covered by each growth stage.

Figure 1 also indicates that we will have to carefully plan our current logging methods in order to increase wood supply. It will be necessary to implement innovative measures in the field of sylviculture in order to increase the potential supply of wood from the current young age and regeneration classes. In order to obtain a better balanced age class, we recommend an increase in sylvicultural activities, such as reforestation and tending.

MAIN ECONOMIC FACTORS

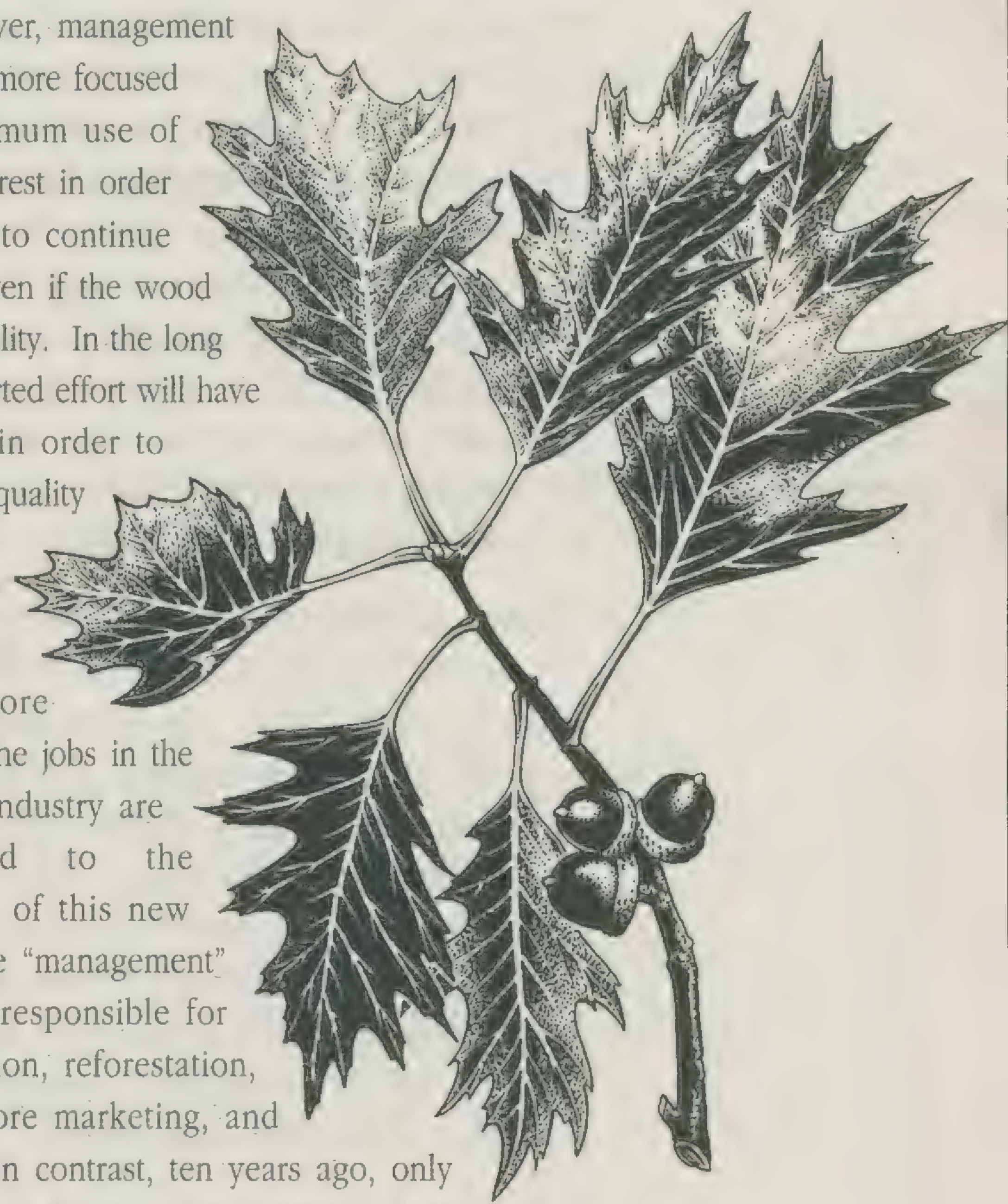
Today the forest industry continues to be the mainstay of the province of New Brunswick. More than 33 cities depend solely on it. Province-wide, it employs more than 16,000 persons (one job out of seven). The people who live in the proposed model forest area draw their revenues from the forest industry, not only from logging operations, but also from services to the industry and activities related to forest management.

10.5%	3.6%	42.3%	43.6%
under regeneration	young trees	immature trees	mature and overmature trees

Figure 1. Age classes in the productive forest land of the Fundy Model Forest.

Two main sawmills and three smaller plants employ more than 450 locals. Two St. John pulp-and-paper plants are supplied in part with wood cut in this area. In St. George, a medium-sized, corrugated cardboard plant is partly supplied with wood cut in the model forest. In Norton, a special products plant manufactures cedar fence components. As the unemployment rate is high, the added value from the sale and supply of forest products to the plants and sawmills as well as forest management are an important stabilizing element for these communities and take on a capital importance for their survival.

As already mentioned, in the past, selective cutting was a current practice in the proposed model forest area. Today, however, management practices are more focused on the maximum use of the mature forest in order for sawmills to continue operations, even if the wood is of poor quality. In the long term, a concerted effort will have to be made in order to improve the quality of the new forest. It is interesting to note that more than half of the jobs in the local forest industry are now linked to the management of this new forest. These "management" workers are responsible for site preparation, reforestation, thinning before marketing, and evaluation. In contrast, ten years ago, only about 10% of the forestry workers were employed in the reforestation sector.



While J.D. Irving Limited exploits its free-tenured properties and Crown timber licences, it also implements an active forest management program on its two properties. More than 120 persons look after obtaining wood products, and 175 others are responsible for forest management (inventory, planning, site preparation, reforestation, and thinning before marketing). The forest management program implemented by J.D. Irving Limited is known and respected throughout North America. Since 1957, the company has supported a reforestation program, which to this day, has seen the planting of 268 X 10^6 trees on its free-tenured properties. This year, the company plans to plant more than 15 X 10^6 trees. It has committed itself to implement state-of-the-art forest management programs and to develop new tools and techniques to further improve forest management. J.D. Irving Limited has acquired an international reputation in the areas of reforestation, seedling nurseries, genetic improvements, propagation by cloning, and improvements in logging methods.

In addition to the efforts expanded by J.D. Irving Limited, the SNB, a partner in this proposal, is not only responsible for the management of the wood supply—starting at the woodlots and ending at the processing plants—and for finding markets on behalf of the woodlot owners, but it also plays the role of forest manager. As such, it strongly encourages the development of good forest management techniques. This way, woodlot owners receive services and advice related to forest management, financial advice on the different government programs to which they are entitled, and advice on the management of different programs offered by the federal or provincial governments.

The approximately 3,000 owners of woodlots registered with the SNB own 200,000 ha of productive forest land within the Model Forest. The proportion of woodlots within the Model Forest represents aproximately 60% of the total woodlots owned by the SNB. About 10% of this area receives some kind of tending. Since the SNB was created in 1977, sylviculture has been carried out on almost 3,275 ha of the Model Forest. The SNB total annual harvest is 240,000 m^3/year (57% pulpwood, 34% studwood, and 9% sawlogs). The total annual harvest of deciduous trees does not usually exceed 15,000 m^3/year.

Harvest from the woodlots and sylviculture represent the main or secondary income for 2,000 persons in the SNB territory. The woodlot owners belonging to this cooperative annually generate $7,000,000 in added value for the rural communities of southern New Brunswick. As well, several owners produce Christmas trees, maple syrup, and firewood. Most of the harvest is done by the owners themselves.

Every year, the SNB plants about 450,000 seedlings on specially prepared sites and treats 600 ha in order to improve the stands in the proposed Model Forest. Most of the sylviculture carried out on private woodlots is accomplished through a program whose cost is shared between the owner of the woodlot and the Canada-New Brunswick Forest Management Agreement. These are the only activities that can be realized within the financial limits of the current program. However, it is possible to establish the possible immediate increase in these activities by examining the list of requests put forth by woodlot owners who want to invest in this program and other similar sylviculture programs.

SECONDARY RESOURCES

Other economic forest opportunities, aside from industrial logging, abound in the region: tourism, firewood, Christmas trees, maple syrup, and wildlife.

Twenty-five thousand Christmas trees are cut annually on lands within the Model Forest area, bringing in $350,000 to the producers. About 1,000 ha are reserved for the production of maple syrup. The commercial value of the 80,000 to 90,000 litres of syrup produced annually ranges between $480,000 and $540,000. This production represents about 25% of the provincial production.

Deciduous trees in the Fundy Model Forest are relatively under-exploited. By-products include a minor quantity of veneer logs, good quality sawlogs, pulpwood, and firewood. It is possible to actively manage these trees. It should be noted that the lack of a market for decidous trees entails an increase in their percentage of the forest cover. This is the case throughout the province. A firewood plant could be built in the Sussex area, and therefore use the surplus of poor quality deciduous trees.

Recreation infrastructures in the region include lookouts built along the Bay of Fundy coast, as well as in the park itself. Fundy National Park is the main attraction in the area. More than 180,000 visitors per year visit this provincial tourist attraction, and the economic fallouts from tourism are considerable. Park visitors contribute $2,000,000 to the local economy. In addition, 70 park-related jobs are created annually. Its budget for salaries and wages is $2,200,000; supplies and services $600,000, and an average of $3,000,000 for its annual investment program. The annual budget for studies within the park stands at $550,000. The principal objective of the studies is to further improve the concept of ecologic stability and its application to park management.

The inclusion of the park, whose approach focuses on ecology, tourism, and recreation, in the territory of the Model Forest allows for the development of a comprehensive forest management plan. It provides as well a vehicle for communicating relevant information to park visitors who come from different corners of the province, from elsewhere in Canada, and even from outside Canada.

Access to the coastal area of the Bay of Fundy is difficult from St. Martins up to the park. However, a grass-roots movement is pushing for the construction of a hiking trail open to motor vehicles, or two trails to accommodate the different users, along that part of the coast. A feasibility study on the "Fundy Trail" is now being carried out.

Other tourist attractions include the diverse rural areas with its undulating landscape and cultivated fields interspersed with farm woodlots. The numerous historical sites spread out on the territory remind the visitors that a large part of Canadian history happened right here in the Fundy Model Forest.

CURRENT STATE OF RESOURCES

The more complex forest management practices being applied in New Brunswick are evolving rapidly. This is the result of a large number of factors and perceptions. Firstly, in the province, there is a marked imbalance between the yield of the wood supply and the predicted demand for forestry products. There follows the adoption of the Crown Lands and Forests Act in 1982. This law leads to the adoption of other similar forest management policies for the large free-tenured properties.

Secondly, increasing environmental concerns and new values attributed to non-industrial resources have encouraged forest owners to modify their logging operations. They have no other choice but to take into consideration the quality of drinking water and animal habitats in the development of their management projects. Managers of forest resources are more conscious than ever of the complex interactions of life forms in the forest and of the importance of maintaining a biological and physical diversity to ensure the health of forest ecosystems.

A third incitement to perfect new methods of forest management has been the development of computerized programs suitable for the resolution of several problems related to resources, and this, on large spacial and temporal scales. New Brunswick has made rapid progress in the use of geographic information systems (GIS), which have spectacularly increased the capacity of forestry resource managers and scientists to manipulate, model, and monitor forest landscapes. These systems allow the inclusion of a larger number of forest ecosystem characteristics in management projects. Already, we have a better understanding of forest dynamics. We are also expending more effort in forest management and in the development of sophisticated models for wood supply.

The improvement of the technology relative to forest management in New Brunswick was well described by Erdle, T.A. and Frame, D.C. (1991) who stated that "the constant improvements born out from our efforts in forest management depend foremost on our ability to identify the shortcomings and limits of our current forest management practices and then, on our ability to develop measures that will allow us to overcome our current weaknesses in forest management". The Model Forest proposal will include the implementation of a program targeting an integrated resource management plan for multiple uses.

Table 2 describes the land structure of the Model Forest. The portion belonging to the Crown is managed by the New Brunswick Department of Natural Resources and

Table 2.
Properties within the Model Forest.

PROPERTY	AREA (ha)	% TOTAL
Small private businesses	262,424	63%
J.D. Irving Limited free-tenured land	70,806	17%
Other industrial properties in free tenure	3,570	1%
Crown lands (Fundy logging permit)	61,766	15%
Fundy National Park	20,700	5%
TOTAL	**419,266**	**100%**

Energy on the authority of the Crown Lands and Forest Act promulgated in 1982. Several of the policies described in the law are also applicable to properties in free tenure. Sylviculture is carried out according to provincial standards and guidelines. The extent of sylviculture carried out on the properties in free tenure owned by J.D. Irving, Limited tends to be higher.

The Crown forests and lands are administered by virtue of a two-stage planning system according to the recommendations described in the Guidelines for Forest Management, prepared by the New Brunswick Department of Natural Resources and Energy. This document consists of a 25-year management plan and a short-term annual exploitation plan. The Crown has established permitted levels for sustainable exploitation and sylviculture. The Crown logging permit in Fundy also allows 23 sawmills holding secondary permits to supply themselves with wood from Crown lands, within the limits of the allocation of milled wood.

Table 3 illustrates current forest management levels in the three actively exploited land properties of the Model Forest over the last five years.

In summary, the numbers in Table 3 show that in the proposed Model Forest, more than 4,000 ha and 375,000 m³ of wood are cut, nearly 4,000,000 trees are planted (1,900 ha reforested) and 1,000 ha of forest where natural regeneration occurs are tended every year.

We estimate that aproximately $3,400,000 are spent annually to implement different sylvicultural measures in the Fundy Model Forest ($1,000,000 in private woodlots, $900,000 on Crown lands, and $1,500,000 on the properties in free tenure of the Irving company).

The management of non-commercial resources, like tourist attractions, animal habitats, and the coastal region, is carried out according to provincial standards and is directed by the competent federal and provincial authorities. Activities inherent to non-commercial resources have been limited to the maintenance of migratory corridors, the protection of caribou winter habitats, moose-fawning habitats, and the nesting habitats of predatory birds , and to measures aimed at protecting water quality. Projects aimed at improving fish habitat are being implemented, like the construction of dams to control river flow, the removal of obstacles to water flow, culvert improvements, and the stabilization of river banks. These activities have been implemented by different departments on all the types of land properties.

CONCLUSION

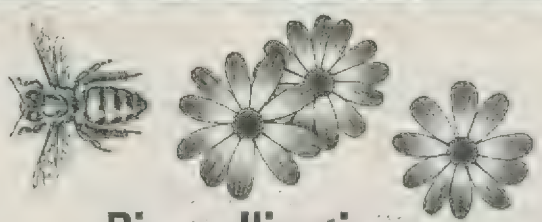
This model forest project is unique in the sense that it covers a sample of land owners and players, and entails active public involvement. Its considerations and objectives are as diverse and fascinating as the area itself. The strategic goals and built-in challenges of this proposal are to develop and implement an environmentally focused, integrated, and sustainable management strategy of the resources of this particular area.

The area covered by the Fundy Model Forest is ideally suited for a sustainable development project. Apart from being a unique and renowned recreation site, the importance given to it by the forest industry and the land owners confers a certain prestige to this project. It is understood that the road will be strewn with questions and problems. Hard work, research, and collaboration will give us the answers. We have realized that our goals will not be reached in the short term. Whatever the point of view, this is a long term project whose objectives will be modified and adapted according to emerging needs and priorities. However, by the end of the five-year study, we hope to have an effective operational plan ready to implement for the area.

Table 3.
Forest management in the Fundy Model Forest from 1986 to 1991.

	REFORESTATION		**NATURAL TENDING**	**HARVESTING**		
PROPERTY	**Trees**	**hectares**	**hectares**	**ha**	**m³ softwood**	**m³ hardwood**
Private woodlots	1,950,000	1,025	2,250	12,000	1,200,000	70,000
Crown lands	6,200,000	3,098	723	4,210	360,000	60,000
Free-tenured industrial property	11,000,000	5,254	2,259	4,240	320,000	80,000
Total	19,500,000	9,377	5,232	20,450	1,880,000	210,000

ECO SERVICES



Bio-pollination:

Love in the plant world benefits the whole world

This is the first in a series of notes on eco-services, those ecological services provided by biodiversity on which all life, including humankind, depends.

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ECO-SERVICES AND THEIR VALUE

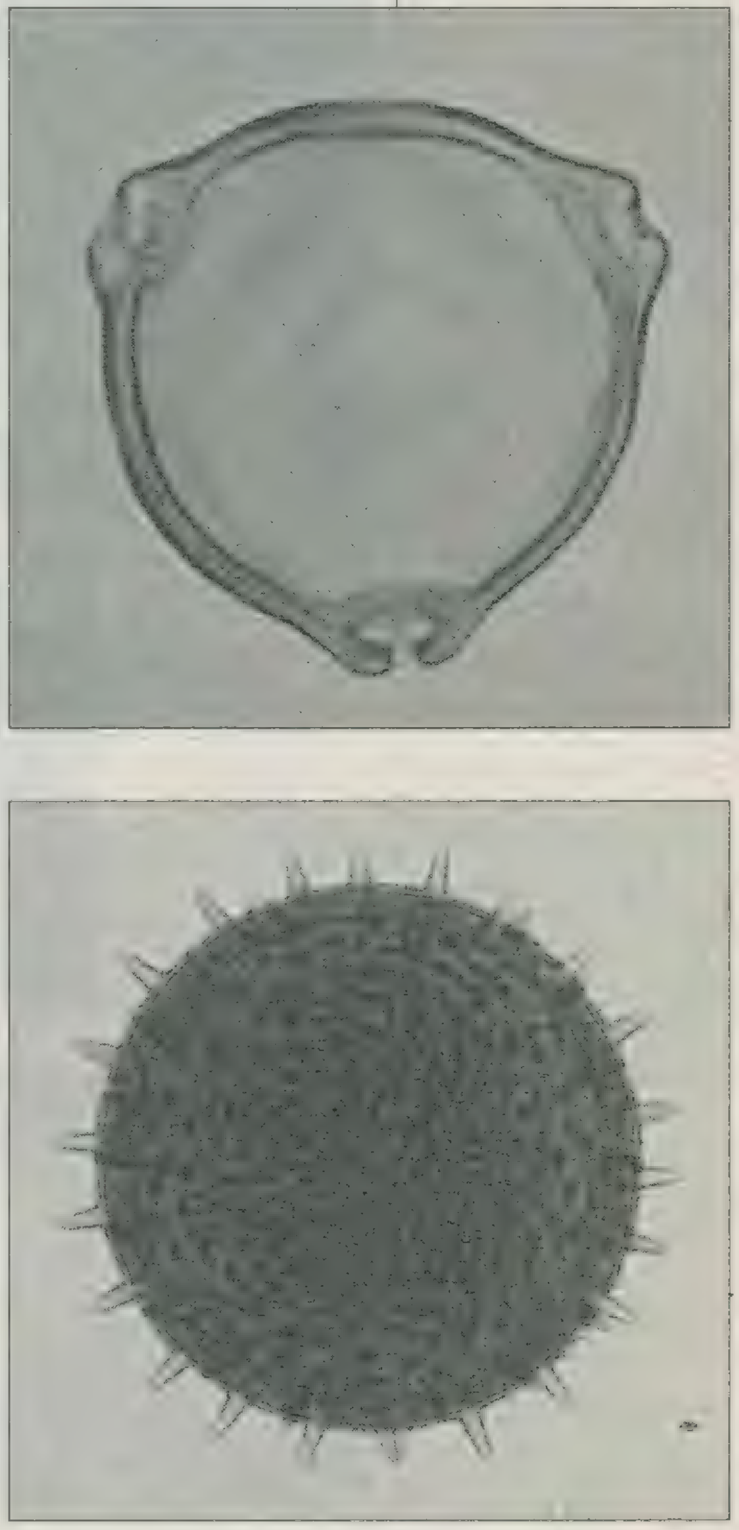
Ecological services or functions are those processes or products that a species or group of species provides to other species. In turn, the recipients' chances of survival increase. In short, we call them eco-services. These interspecific and bio-physical exchanges are called services because they sustain other species directly or indirectly. For instance, pollination directly affects the survival of flowering plants, while trees maintain oxygen levels around the globe, indirectly affecting all species. Other examples of eco-services include recycling of nutrients in the soil, creation of three-dimensional habitat for other organisms, moderation of the runoff from rain and snowmelt, and fixation of nitrogen (Mosquin and Whiting 1992). The services, provided by one species, sustain other species directly, or sustain the physical environment on which they depend. The ecosphere, the inseparable living and non-living environments, is thus supported by a number of interlinking processes. The more we understand these processes, the less likely we are to damage them.

Excluded from eco-services are those functions or products, or part thereof, that benefit solely the species creating them. So nitrogen fixation in the soil by one species is an eco-service insofar as it benefits one or more other species. On the other hand, while a gull feeding its young with fishes certainly benefits those young, it is not an eco-service. In short, eco-services are services to other life-forms or environments, not for one's own species alone.

POLLINATION AND ITS VALUE

Pollen consists of tiny powderlike grains developed within the anthers of flowers, and is the male element of a flower that fertilizes the ovules or female element. Flowers with anthers and ovules are found in the flowering plant group called Angiosperms. The stigma, an extension of the ovule, receives and traps the pollen on its sticky surface. The stigma normally permits only those pollen grains from the same species to grow tubes toward the ovule, carrying the male genetic material. Pollination is the transport of pollen from the anthers to the stigma, while fertilization is the successful union of male and female genetic material that may follow pollination.

Because flowering plants cannot move as animals can, means of pollen transport to the ovule had to evolve. Pollination may be carried out by forces of nature, such as the wind, or rarely, water currents, or by a biological agent. Some insects, bats (see article by M.B. Fenton, 1993, *Global biodiversity* 3(1)), or birds participate in bio-pollination (Jarzen and Nichols, in press). Some plants self-pollinate, but most normally cross-pollinate.



Wind-pollinated flowers tend to have numerous, smooth-surfaced pollen grains. In contrast the pollen of bio-pollinated plants commonly bear spines, hooks, or netlike surface structures. All the better for clinging!

Photos by David M. Jarzen, Canadian Museum of Nature

Cross-pollination carries with it the general advantage of sexual reproduction; that is, successful genes from two different individuals can be recombined into a new individual, providing a richer hereditary matrix for evolution to act upon. Bio-pollination is the eco-service that is discussed in this article.

Those species that cross-pollinate are usually self-sterile, and therefore, pollination is a crucial step in the life cycle. If pollination does not occur, the seeds will not be fertile, and a new generation of plants will not be produced that year (or any year, if it is an annual plant). Pollination is crucial for farmers, too. If the blossoms of apple or other fruit trees are not fertilized, there will be no fruit. The farmer who produces alfalfa seed for other farmers, must ensure that pollination occurs if he is to have seeds to sell. Pea and bean seed production may be reduced by 60% to 70% if honey bee colonies are not in the immediate vicinity of the crop. Maple trees, and many others, depend on insect pollination. Where the crops are wind-pollinated, as in most of the grains, pollination is less at risk. Where pollination is carried out by an insect or other animal, then the farmer must ensure that the insect partner or partners are available. Heavy rains during flowering may reduce both kinds of pollination. In Canada, the economic value of pollination of orchards and various crops by bees and wild insects has been estimated at $1.2 billion per year (Mosquin and Whiting 1992). Globally, bees pollinate more than 2,500 species of crop plants (Heinrich 1979). The pollination of wild flowering plants - herbs, shrubs, and trees - represents an enormous value to the biosphere that cannot be computed.

Photos of the variety of wild insects pollinating flowers of the Canada plum, *Prunus nigra*, in Lanark County, Ontario, Canada in May.

- *The value of insect pollination of crops and orchards in Canada exceeds $1.2 billion.*

POLLINATING PARTNERS

There are about 250,000 described species of flowering plants. The majority of plants rely on one or more animal partners, mostly insects, to carry the pollen from one plant to another. Some plants use many pollinators. For instance, bees, beetles, and flies were observed visiting the blossoms of a wild Canada plum this May, in Lanark County, Ontario. Many flowers, such as those of fig trees (genus *Ficus*), certain orchids, alfalfa, and clover can be pollinated by only a single species, or a small group of insects. When clover was first introduced into New Zealand, it would not produce fertile seeds until the bumblebee (genus *Bombus*) was introduced in 1865. This was shortly after Charles Darwin and his contemporaries had discovered that red clover requires bumblebees for its pollination. A small lizard, native the Atlantic island of Madeira, visits and pollinates one of the native plants (*Echium*).

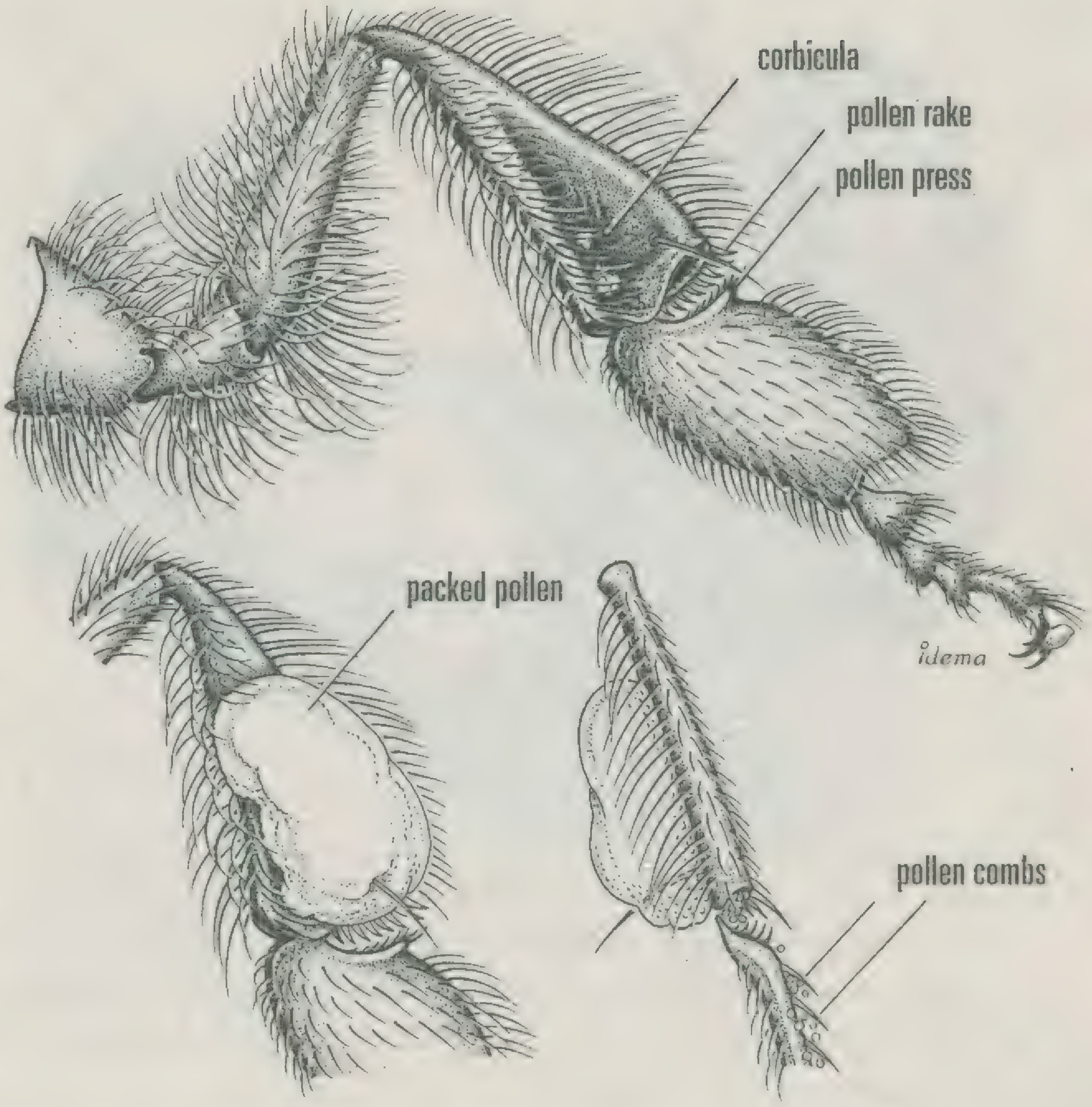
Alfalfa seed farmers cultivate leaf cutter bees (genus *Megachile*) and the alkali bee (genus *Nomia*), the only insects capable of fertilizing this plant. The bottom part of the alfalfa flowers sag under the bee's weight, activating a trip mechanism that deposits pollen on the bee and dusts the ovule with pollen from previous flowers. Some insects are too small to trip the mechanism; other insects can trip the mechanism, but dislike and avoid it. This is just one example from a number of specialized partnerships between plants and pollinators. Not just any pollinator will do for such plants. Obviously reduction or extinction of the specialized pollinator population will have similar effects on the plant. Other plant species are less at risk, since they are pollinated by a variety of species.

▪ *The survival of most wild plants depends on insect and other pollinators.*

SIGNALS AND ATTRACTIONS FOR POLLINATORS

Many plants need bio-pollinators, living partners that transport the pollen, but why should the bio-pollinators transport pollen? For rewards! One reward is nectar. Nectar is a sweet fluid containing carbohydrates that the plant secretes into a special chamber or on the plant's receptacle. Bees, butterflies, hummingbirds, and some bats visit flowers to find nectar. When a pollinator dips into the nectar, it brushes against the anthers and rubs off the pollen, which is then carried to the next flower. At the same time, the pollinator leaves behind some pollen from previously visited plants. Some insects, like bees, feed on pollen, or collect it for their larvae. The bees' hairy hind legs have a special, bristle-free groove (the corbicula) to collect and carry the pollen. Again, some of the pollen is transferred from one flower to another.

Flowers have evolved unique mechanisms to signal their presence to pollinators. The flower petals act like a flag to attract attention. Their colour, size, and shape are perfectly designed for the pollination partner(s). To attract bees, petals may reflect light in the ultra-violet range, to which bees are sensitive. Hummingbirds seem especially attracted to red, nectar-bearing flowers. Fly-pollinated flowers tend to be white, butterfly-pollinated flowers are red, and bee-pollinated flowers have a dazzling array of visible and (to us) invisible colours. Wind-pollinated flowers tend to be small, inconspicuous, and without colour, odour, or nectar, but with numerous smooth-surfaced pollen grains. In contrast, the pollen grains of bio-pollinated plants commonly bear spines, hooks, or netlike surface structures to attach themselves to the pollinator, and are produced in smaller quantities. Night flowers are usually white for greater visibility. Some flowers attract male pollinators by imitating the female; in attempting to mate with the lookalike, the male is dusted with pollen. For instance, the European looking-glass orchid (*Ophrys speculum*) mimics in scent and appearance a female wasp. Although the males that attempt to copulate with the flower get nothing in return, the orchid is pollinated (Heinrich 1979).



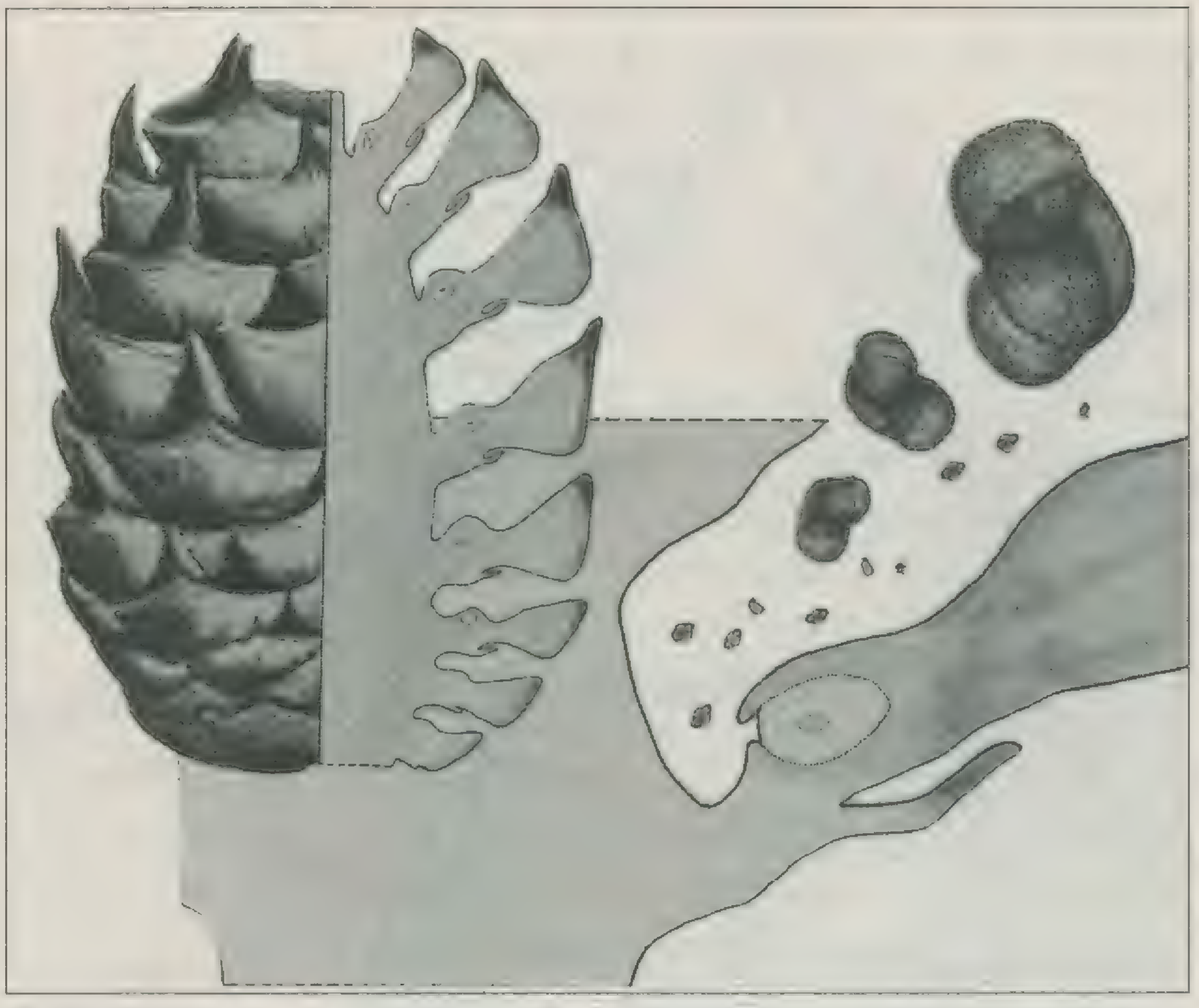
a. Outer view of the left hind leg of a worker honey bee
b. The same leg, showing packed pollen in the corbicula
c. The same leg with its pollen load, as viewed from behind

The worker bee manipulates the pollen with rubbing motions of its hind legs and the aid of the pollen combs, a pollen rake, and a press.

Drawing of the corbiculum or pollen "saddle" that bees use to transport pollen.

Many flowers use perfumes as attraction signals; perfumes are especially prominent in blossoms that open at night. The spectacular creamy-white flowers of the yucca plant (genus *Yucca*, family Agavaceae) found in New World deserts is pollinated by the nocturnal female yucca moth (species of the genus *Tegeticula*) (Whitford 1991). The larvae of the moth feed on the fruit of the yucca plant. Typically only one of the four segments of the fruit will contain a yucca moth larva. Those yuccas transplanted from their native habitat will not reproduce because the yucca moth pollinator is absent. In fact, collection of wild yucca specimens for horticulture may be endangering some wild populations of yucca. •

Donald Perry, who studies life in the jungle's tree-top canopy, has discovered a new type of pollinator (Perry 1986). The canopy-climbing vine, *Norantea sessilis*, has small buttonlike flowers. These flowers produce an abundance of nectar that attracts birds. The flower's sticky pollen adheres to the feet of birds and is carried from flower to flower. Many of the birds are wintering warblers from North America. Flowers of other rain-



Wind-pollinated plants, such as Canada's conifers, are not sensitive to the loss of a pollinating partner. Photo by Harry Foster, Canadian Museum of Nature

forest giants are pollinated by tiny insects. Loss of either jungles, pollinating insects, or warblers will break these fragile links. Canada's conifers, on the other hand, are wind pollinated, and so are not sensitive to the loss of a pollinating partner.

A number of restrictions limit the insects that will pollinate a particular plant.

- There may be highly specialized relationship between pollinators and plants, as we have discussed.
- The geographic range of the pollinating species has to overlap with that of the plant to be pollinated.
- Only those insects available during blossoming time are possible pollinators.
- Flower morphology or shape dictates, to a certain degree, the shape and size of a successful pollinator.
- The behaviour of the pollinator, whether it is high or low flying, diurnal or nocturnal, nectar feeder or not, and many other factors determine which insect(s) will pollinate a particular plant.

These restrictions suggest that there is a limited number of pollinators for each plant, and that this partnership and eco-service is subject to disruption.

To learn more about the fascinating flower-bee partnership read Heinrich's (1979) book *Bumblebee Economics*, which refers to natural, not fiscal economics. Other literature is suggested under Further Reading.

DISRUPTION OF THE ECO-SERVICE

Reproduction and survival of bio-pollinated plants, and the success of a major part of our agricultural industry, depends on the well-being of insects and other pollinators. As previously discussed, in some cases the reproduction of a plant is narrowly linked to a single pollinator, and disappearance of the pollinator may spell disappearance of the plant species. In other cases, as in our orchards, successful pollination may depend on domestic bees and a number of wild pollinators. In the latter case, reduction in population of one or several of these pollinators will result in a reduction in successful seed and fruit setting.

Human activities often interfere with pollination. The use of insecticides, especially broad spectrum insecticides, may decimate the populations of pollinators needed to fertilize a wild or domestic plant species. Pollinating insect populations are reduced or almost eliminated because of the heavy orchard use of insecticides, and then orchard growers have to pay beekeepers to place beehives in their orchards at blossom time. Insecticide spraying and habitat disturbance are reducing the number of leafcutter bees, and farmers growing alfalfa for its seed are obliged to buy leafcutter bees to ensure good seed set. The aerial spraying of forest insect pests no doubt disrupts some of the insect pollinators of wild flowering plants. How much information is available on this phenomena?

- *Wide-sprectrum insecticides and other human activities may interfere with flower pollination.*

As the natural habitats around farms and orchards are displaced or disrupted by larger, mechanically tilled, crop areas, woodlots and hedge rows are reduced. With them, the habitats for wild pollinators are reduced, which means fewer natural pollinators. Large fields of crops may attract pollinators away from wild plants and decrease their seed set; that fact needs to be taken into account in reserves intended to save wild flowers. Also, it is possible that the invasion of exotic plant and insect species will alter the balance between native plants and their pollinators. The exotic purple loosestrife, accidentally introduced from Europe, has displaced significant numbers of native wetland plants in eastern Canada and United States. Will this also decrease pollination of nearby remaining native plants?

If we are to sustain and regain harmony in the environment, we need to better understand the relationships between pollinators and the wild and domestic species of plants they serve. Pollination is an important eco-service rendered by wild and domestic pollinators in most countries on this planet. As keystone species, the status of pollinators (of wild as well as of cultivated plants) should be included in environmental monitoring programs.

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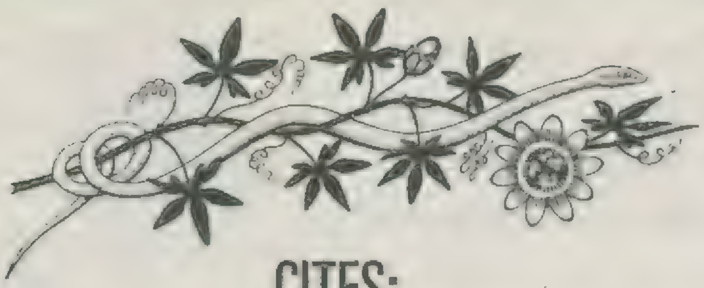
Insects are vital pollinators of many of the world's wild herbaceous plants and forest trees, as well as many crops and orchards. Without pollination the seed would not set or be fertile.

Photo by Harry Foster, Canadian Museum of Nature



CITES:
Is it working?

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The Convention on International Trade in Endangered Species of Wild Fauna and Flora, universally known by its acronym CITES, became operational on July 1, 1975 after the tenth nation had deposited instruments of ratification. By the end of July 1991, 112 nations had ratified or acceded to the Convention, making it one of the most universally accepted Conventions in the field of the environment. It is an international trade agreement monitoring the international movement of over 48,000 species and subspecies of wild fauna and flora, including their respective parts and derivatives.

It is not law in itself, but must be applied and enforced through domestic legislation in participating countries. While it regulates the international movement of listed wild mammals, birds, reptiles, amphibians, fish, insects, spiders, leeches, mollusks, corals, and plants, it does not impinge upon domestic management or use of such species nor does it require appropriate management of habitat to maintain the species. Fauna and flora listed must be threatened or are likely to become threatened by international trade.

The number of stuffed specimens, such as these spectacled caimans, seized at the border is astounding.
Photo by Jadwiga Frank, Canadian Museum of Nature

Species are listed in the appendices: Appendix I includes those species and subspecies that are endangered through trade; Appendix II, those species/subspecies that are in trade and for which such trade should monitored; and Appendix III, those species that are managed within a party nation that are in trade and for which the listing nation seeks international assistance in monitoring trade. CITES permits must be obtained before any international transfer of specimens takes place. For those species and subspecies listed under Appendix I, an import permit must be issued by the country of import and an export permit must be issued by the country of export. For species listed under Appendix II only an export permit is required, and for Appendix III, an export permit or certificate is required. Only the designated Management Authority of the participating nation may issue CITES permits and certificates. While the Articles of the Convention are the minimum requirements that must be adhered to, participating nations may have more stringent requirements, which in turn, should be respected by other nations.

▪ *One problem is the loose wording of the Articles of CITES, which results in as many intepretations as there are states participating.*

Although the Articles may appear to be straight forward and as close to "motherhood" as you can get, they are in fact loosely worded, resulting in as many interpretations as there are states participating. In an attempt to solve the dilemma, Parties have adopted Resolutions interpreting the problem Articles. Unfortunately many of the Resolutions are complex and they themselves require interpretation. To complicate matters further, Resolutions are not binding on the Parties as are the Articles. While many parties have been able to agree on similar interpretations of Articles and Resolutions in so far as domestic legislation allows, the international application and enforcement of the Convention is far from satisfactory. To complicate matters further, the appendices of regulated species are very lengthy, and the species and subspecies are often difficult to identify especially when parts and derivatives are involved.

The Articles require that "readily recognisable" specimens be regulated, but what does this mean? "Readily recognisable" to an untrained Customs Inspector or "readily recognisable" to a biologist experienced in identification of wildlife products? How does one "readily recognise" a stock of meat from a Plains Bison (not listed) from that of a Wood Bison (Appendix I)? Can "readily recognisable" be an interpretation of a label? Many oriental medicinal products list ingredients such as a "rhino horn" and "tiger penis," but there is no indication of the amount of such products in the medicinal product. What about "ginseng" tea being traded from Korea? North American *Panax* is listed under Appendix II while Korean ginseng is not listed. However, Korea imports a considerable amount of North American ginseng. The list of problems goes on and on.

We must take a close look at the Canadian application and enforcement of CITES. How good is it? Can it be improved? How? How do we compare with other comparably sized nations? To find the answers, we must look at the legislation, the funding of the program, who is involved and at what level, and the apparent general will of those involved with the application and enforcement of CITES.

The current legislation used—the Export and Import Permits Act administered by the Department of External Affairs—is inadequate and inappropriate for the proper implementation of CITES. The Act allows only the designated authorities in the Canadian Wildlife Service, Agriculture Canada, and the provinces and territories to issue CITES permits and certificates. The Act is enforced by Canada Customs at points of entry to Canada.

But CITES is more than import and export controls. It is the management of all aspects of international trade in specific species of wild animals and plants. The Act does cover all imports to and exports from Canada including nuclear material, pornography, and turkeys. It is a piece of all-embracing general legislation, which allows inadequate penalties for the protection of the world's wild natural resources. The human population depends upon many of these natural resources for survival, such as certain wild plants used for the preparation of medicines.

CITES regulates many products made from endangered animal species, such as painted turtle-shell masks, snake-skin boots, instruments inlaid with ivory, animal-skin purses, and the list goes on and on. Tourists should not buy or try to import such products.

Photos by Jadwiga Frank, Canadian Museum of Nature

As the Control Lists authorized by the Act can only be made through Orders-in-Council recommended by the Secretary of State for External Affairs, amending these Lists takes an excessive period of time. One must labour through the bureaucratic jungle of two or more departments as well as the public hearings process used by External Affairs. It just is not possible to react rapidly enough to newly list a species that is suddenly subject to increased international trade and threatens extirpation of the species.

Under the British North America Act, all wild natural resources—with the exception of migratory birds, fish, and marine mammals, and wildlife on national lands and in the two territories—are the responsibility of the province in which they occur. The exceptions are federally managed, although the federal government has delegated its responsibility of wild fauna in the territories to the two territorial governments. Thus the management of wild natural resources in Canada is subject to internal management by 13 federal, provincial, and territorial governments, and all must be involved in the internal management of CITES. The movement of all goods, including wild fauna and flora, in and out of Canada is subject to federal jurisdiction making the federal government responsible for CITES at the international level. Because of the internal management situation, a number of federal departments and all provincial and territorial governments are involved with the CITES permit-issuing process and the preparation of status reports on all Canadian species. All aspects of the management of CITES, both internally and externally, are coordinated and controlled by the Canadian Wildlife Service of Environment Canada. In order to ensure a standardized application of CITES in Canada, the Canadian Wildlife Service provides Operational Policy Guidelines for the management of the Convention in Canada.

▪ *Is it reasonable to expect a Customs official to recognize the over 48,000 CITES species and subspecies?*

Effective enforcement is the most important aspect of CITES. In Canada, the Export and Import Permits Act is enforced by the Customs Act and administered by Canada Customs at Canadian ports of entry and exit. In essence, it is the responsibility of a Customs Inspector inspecting baggage on entry to Canada to enforce the requirements of CITES. While Customs Inspectors are trained at the Customs College in Rigaud, Québec and "on the job," their basic training involves revenues collection through excise duties and not the recognition of CITES-regulated species and their respective parts and derivatives. Unless an Inspector has a biological background, it is unreasonable to expect the officer to be able to recognize the over 48,000 species and subspecies regulated by the Convention. Even a fully trained biologist or scientist will not be able to "readily recognise" all endangered species, parts, or derivatives without reference to other specialists and libraries. The federal government has failed to accept this fact and has not provided funding and person years for a team of appropriately qualified experts to support Customs Inspectors at ports of entry and to Royal Canadian Mounted Police (RCMP) officers dealing with goods smuggled into Canada. While the Canadian Wildlife Service, Canada Customs, and the RCMP are doing as much as they possibly can with inadequate funding and person power, the international application of CITES by Canada is inadequate and must be improved.

This crocodile has been stuffed, mounted in an unnatural upright position, and had its mouth painted bright pink.

Photo by Jadwiga Frank, Canadian Museum of Nature

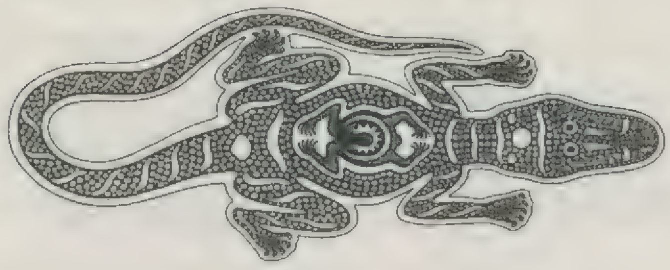
Canada must ensure that adequate funding is available before new Conventions and Agreements are signed in order to increase the scope of the unfortunate situation CITES is in. Canada is not pulling its weight, and its international reputation is suffering accordingly. Environment Canada, read the Canadian Wildlife Service, needs a considerable increase in funding so that

- appropriate training programmes can be offered to Canada Customs, the RCMP, and permit issue staff,
- qualified support scientists, biologists, and enforcement officers be employed to create an effective and on-going public awareness program concerning endangered species and CITES
- these awareness programs can be directed at all Canadian travellers, tourists, importers, exporters, dealers, and the many educational systems. Many people do not appreciate or are not aware of the seriousness of depleting the world's wild natural resources upon which humans so much depend. Assistance must also be provided—in the form of hard cash and expertise, not in "motherhood" comments and assurances—to producer countries, especially those in the Third World.

If CITES is not as effective as it should be, what can be done about it? First and foremost, the federal government must begin to take the environment more seriously than it has in time past. Environmental matters must not be placed on the back burner and give way to politically expedient "big business" developments. The destruction of the environment is our destruction. By simply joining the "good guy club" and ratifying CITES, Canada does not fulfil its international commitments.

Before signing any new Conventions or Agreements, Canada should ensure that appropriate legislation is in place and that sufficient funding is available to fully implement the program upon signing. While the proposed new legislation dealing with the protection of wild animals and plants that is now before Parliament will help to improve the existing CITES underfunding and understaffing problem, the proposed Treasury Board funding could still be inadequate to meet today's needs.

Canada has signed and ratified the United Nations Environment Programme's Convention on Biological Diversity. An effective Canadian and international CITES program will be a useful tool in implementing the new Convention.



For Canada:

A Bioregional Senate

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The stranglehold of liberal reductionism ("one person, one vote") and economic reductionism ("a buck is a buck") on the terms of public discourse is nowhere more clearly seen than in the inability of proponents of Canadian Senate Reform to express what they mean by a Senate that would represent "regional interests." Such reformers characteristically live in the less densely populated parts of Canada, and they know in their hearts that the relative political and fiscal weaknesses of their regions are wrong, but they cannot express how they are wrong. That is because they can see value only in votes and money, and without the one they cannot get the other. They cannot say that the mountains and prairies and boreal forest and tundra need representation for their own sake.

The North American Senates were founded to assure the representation of property and money, as well as regional interests. Now that vast amounts of money must be mobilized just to obtain the public visibility needed for election to a lower house, such interests no longer require protection from the masses of people. It seems absurd that historical accident dictates that the tiny state of Delaware and the huge state of Texas are represented by equal numbers of senators in the United States, or that political friendship with the leader of the predominant party in the Canadian House of Commons is sufficient for entry to the Senate. These absurdities and all the current proposals seem "unfair," so perhaps we need a new criterion for "fairness." None of the conventional plans for a reformed Canadian Senate would, overall, improve the fairness of representation of regional interests, because none of them is prepared to strongly contradict the principle of representation by population, except by representing provinces equally. The provinces are patently unequal in size as well as in population, and are already represented by governments with important roles in federal governance.

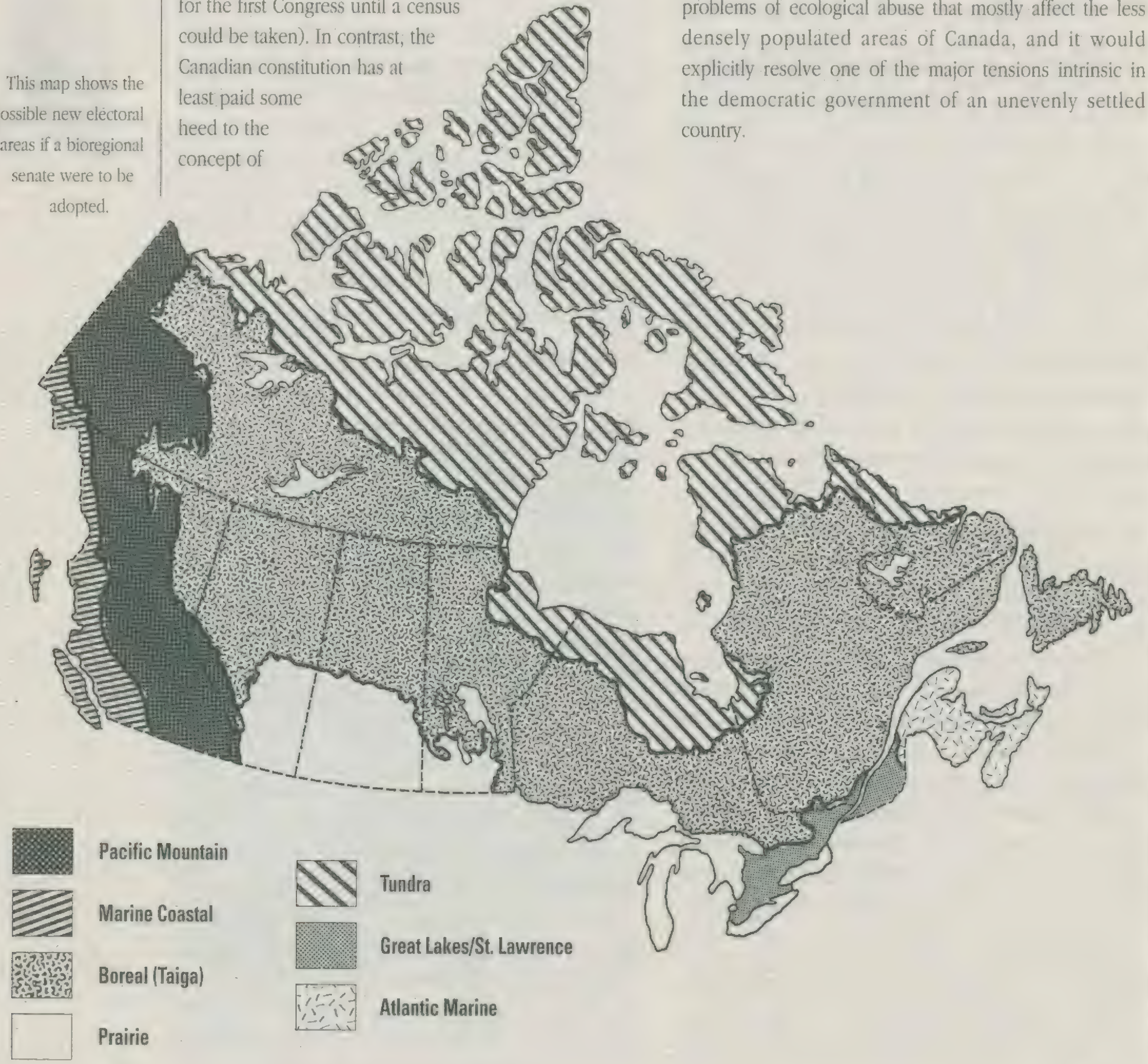
If the Canadian House of Commons represents people, what should another legislative chamber represent? As a naturalist, I do not think that there is any logical answer except "everything else," or at least, since a parliament must be made up of people, people's relationships with everything else. The model for the North American senates—the British House of Lords—represented the landed aristocracy of mediaeval society, so it is appropriate that a modern Senate should represent the land and waters themselves and its nonhuman occupants.

The mechanisms for representing the land and ocean would be different from that of representing people. Election to the Senate would be from districts of equal area or of equal total primary biological productivity or biomass (the amount of plant growth in each season, or the total amount of living organisms). The electoral districts would follow natural divisions of drainage or regional vegetation (like the division of the Northwest Territories, or the Conservation Districts in Ontario), and elections would be separate from those for the Commons. One would hope that qualification for senatorial candidacy would include some assessement of the candidate's understanding of the history, land, flora and fauna, and human occupancy of the electoral district. (Perhaps a formal list of questions on these subjects propounded by each candidate to all the others would form platforms for such elections.) One would also hope that senatorial elections would be occasions for general debate and discussion of land-use or ocean-use policy. Such a Senate would initiate only legislation dealing directly with human relationships with the land and waters or co-occupying species, and at its own discretion, would waive consideration of all legislation originating in the Commons that did not relate to the land.

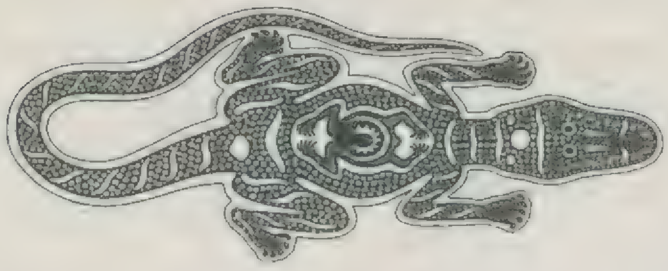
In a reformed Senate, in which the area of land and water or its life is the basis of representation, no area of Canada could claim to be under-represented because of low human population density and the consequent perception of exploitation by urban centres. Ontario and Quebec, two provinces that are ensured high representation in the Commons due to the size of their human populations, would be incidentally represented by the large number of Senators to which their large area would entitle them.

The United States constitution does not take the land into account in any way. It is an abstract document that makes no reference whatever to the particular country it governs (except for apportioning seats for the first Congress until a census could be taken). In contrast, the Canadian constitution has at least paid some heed to the concept of human relationships to specific parts of the country. It has been a patchwork of deals about and between particular provinces, and the recent acceptance of the concept of aboriginal self-government is a further recognition of the close relationships particular groups of people have to particular areas.

A Senate that represents the land or its life would acknowledge that all Canadians have important relationships to the places where they live, the same relationship that is being claimed by the aboriginal nations. This would give real meaning to the "equal" element in the current proposal of a "triple-E Senate" (equal, elected, effective) in Canada. Also, a bioregional Senate would be a major step toward solving the problems of ecological abuse that mostly affect the less densely populated areas of Canada, and it would explicitly resolve one of the major tensions intrinsic in the democratic government of an unevenly settled country.



This map shows the possible new electoral areas if a bioregional senate were to be adopted.



Roots of the Earth

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Roots, though hidden in the soil and often forgotten, are one of the most important parts of land-dwelling plants. They stabilize the plant, and they both prevent it from being blown over by the wind, and counteract the gravity pulling on its unbalanced branches or foliage. They draw life-giving nutrients and moisture from the soil, often with the aid of immense networks of mycos-friendly fungal filaments (McAllister, 1993). But roots form their own vast networks. This root network zone is so important in soils that it has been given its own name—the rhizosphere—from the Latin word rhizo for roots. The rhizosphere is the root-permeated soil zone, usually best developed close to the surface, and includes the many life forms that exist in this root-soil matrix.

The importance of roots can be appreciated from a few simple figures derived from an average hectare (ha) of ground (a hectare is equal to about 2.5 acres). Although the following values vary, an average hectare of forest might contain 4-6 tonnes of roots; grassland, 16; wheat crop farmland, 1.2; and soybean, 0.6 (Davis et al, 1992). In forests about a quarter of the trees' biomass or entire living weight is contributed by roots. In grasslands more than four-fifths of the plants' weight consists of roots. Much of each plant's energy goes into making roots: in trees, about half the energy goes into root production; in grasses, about two-thirds; and in wheat, about one-quarter.

The total length of roots in a given volume of healthy soil is high—about one metre (m) per cubic centimetre (cm^3). Under a square metre of grassland you might expect to find 40,000 m or 40 kilometres (km) of roots. Two and a half hectares of grassland would have about a million km of roots.

▪ *Two and a half hectares of grasslands contain a million kilometres of roots.*

It is obvious that roots are important in terms of function, the plant's biomass, the length of the soil network, and the energy expended by the plant. Roots move millions of kilograms of water and nutrients from the soil up into the stems, trunks, and leaves of plants. The roots are also important to the rhizosphere, one of the Earth's critical ecosystems. As the roots die and the short-lived, fine rootlets are replaced, they are transformed into humus and the nutrients are recycled. In forests and grasslands this is a significant source of humus and soil structure. In wheat and soybean crop soils the root biomass is less than 10% of that found under grasslands, and much less than that found in forest soils. This means that when we convert forests and

grasslands to those crops, the amount of root contribution to soil humus will be greatly reduced. It will be even more reduced if we remove the plant stalks and leaves for straw, forage, or other purposes.

This suggests that root management should be an important part of management of farm and forest lands. The steady decline of the humus content of prairie soils in Canada suggests that more attention should be played to the root zone of plants, as well as several other contributing factors. The organic matter in prairie soils has been reduced by 36-49% (State of Canada's Environment, 1991). Industrial farming has come to resemble hydroponics more and more, where single genetically-uniform plant varieties are used, chemical fertilizers and pesticides are applied, and where the soil is merely used as an inert matrix to hold up the plant, plus provide a few micronutrients. Because this regime impacts the diversity of microbiota in the soil, which naturally recycle nutrients, and because the growth of single crops increases depletion of needed nutrients, this type of farming demands increased input of fertilizer. It is, therefore, not surprising that fertilizer inputs have increased on the prairies from less than 5 million tonnes in 1931 to more than 40 million tonnes in 1986. The loss of humus in the soil also depletes the soil's capacity to hold moisture. Depletion of moisture-holding capacity suggests that the crops will be more sensitive to drought. Is it not time to pay attention to nurturing and protecting those invisible roots, which ensure the health and productivity of plants? After all, without plants, all animal life—including humans—would cease to be.

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This stylized globe symbolizes the roots that hold together the Earth's soil.

NGO CORNER:

West coast environmental law initiatives

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Since 1974 the West Coast Environmental Law Association (WCELA) has promoted protection of the environment. WCELA, a public interest environmental law organization, provides services in five program areas: legal aid, law reform, legal research, legal education, and a library of environmental legal materials. The organization has a core staff of three lawyers and three office members. Approximately 500 lawyers, policy makers, and concerned citizens are members of WCELA.

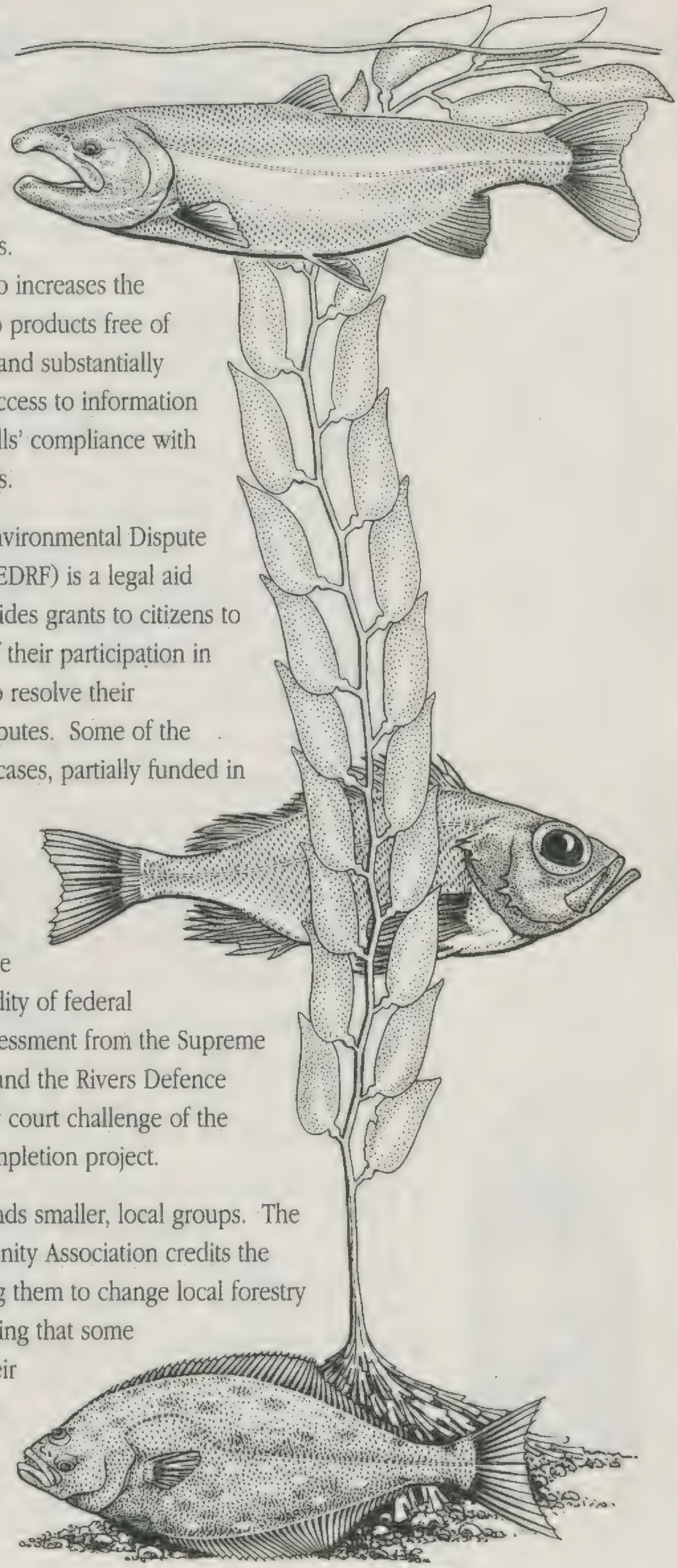
Some of WCELA's major successes have been in the area of law reform. In 1992, for example, the publication Using Conservation Covenants to Preserve Private Land in British Columbia advocated statutory changes to allow conservation organizations to use this effective legal tool. It appears that the provincial government may respond with legislative changes just six months after the report was published.

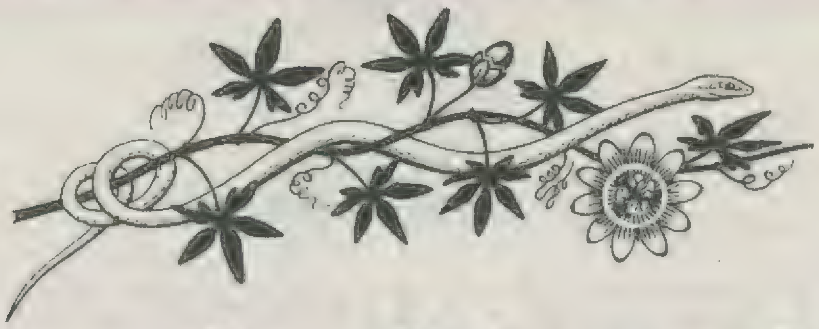
Other successful examples of West Coast law reform initiatives include the campaign for legislated access to information that culminated in the enactment of a Freedom of Information and Protection of Privacy Act in British Columbia in 1991. It also published the influential publication *Preventing Toxic Pollution: Toward a British Columbia Strategy* (1991), which has been used extensively as a model for pollution prevention initiatives by agencies such as the B.C. Toxics Reduction Branch.

The Pulp Pollution Campaign also illustrates WCELA's success with law reform and legal aid. WCELA represented 54 organizations in a campaign against pollution from B.C. pulp mills, resulting in a regulation that requires elimination of organo-chlorines from the bleaching process by the year 2002, and insists on improvements to other pulp pollution standards. The regulation also increases the availability of pulp products free of organo-chlorines, and substantially improves public access to information about the pulp mills' compliance with pollution standards.

The West Coast Environmental Dispute Resolution Fund (EDRF) is a legal aid program that provides grants to citizens to pay for the cost of their participation in different forums to resolve their environmental disputes. Some of the precedent-setting cases, partially funded in 1991-93 through EDRF grants, are the Friends of the Oldman River, the leading case on the constitutional validity of federal environmental assessment from the Supreme Court of Canada, and the Rivers Defence Coalition's lengthy court challenge of the Kemano Dam Completion project.

The EDRF also funds smaller, local groups. The Big Creek Community Association credits the EDRF with helping them to change local forestry practices by ensuring that some of the forest in their region will remain unharvested.





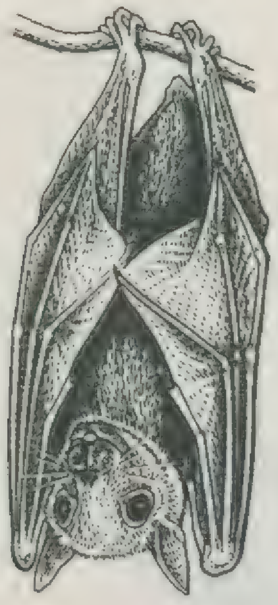
Biodiversity News Notes

Notice of Staff Cuts at the Canadian Museum of Nature, Ottawa

Those persons or institutions regularly using services provided by staff of the Canadian Museum of Nature in Ottawa, Ontario should be advised that a number of staff positions have been cut.

Following reductions in the federal government funding to the Canadian Museum of Nature and Museum management reorganization plans approved by the Museum Board of Trustees, the Museum staff was cut back by 51 positions at the end of July. This constitutes about 20% of the total staff. 39 are permanent positions and 12 are terms. These cuts include 9 researchers (7 scientists and 2 assistants), 6 collection staff, 3 (out of 9) library staff, 13 in the Education and Display Division, and 6 in Business Operations and Publishing (Editor of Biome and Neotoma). 2 of the 39 are from the management ranks. The hardest hit, Education and Display, sustained a 50% loss of staff. All of the cuts, with the exception of 2 managers, occurred in the program areas and represent a 31% reduction. Research in ornithology (birds), mammalogy (mammals), herpetology (amphibians and reptiles), bryophytes (mosses), isopods (in marine relatives of sow bugs), ethology (animal behavior), and palaeomycology (fossil fungi) will be discontinued and in vascular plants research will be decreased. Technical support for collections has been reduced.

Persons wishing to notify laid-off staff of possible job openings or having queries may pass these on via the Editor at: Canadian Centre for Biodiversity, Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario K1P 6P4, Canada, or by fax at: (613) 990-8818. In addition to positions sought in the jobs above, technical positions are sought in molluscs, general invertebrates, ichthyology (fishes), ornithology, crystallography (minerals) and gems.



A new source of taxol

Taxol is the promising anti-cancer agent isolated from the bark of the Pacific yew, *Taxus brevifolia.* Spurned by the forest industry, this tree was not replanted, and the few specimens large enough to supply bark, are located in the remaining old-growth forests with suitable soils and moisture. The bark from six old trees is required to supply the needs of a cancer patient for one year. This means the supply is limiting the amounts of treatment for further testing of efficacy of taxol. Researchers at Montana State University and Montana Tech have found an alternative source of taxol. A fungus that grows on the Pacific yew in Montana has been shown to produce taxol in artificial cultures. Research is now focusing on increasing the small amounts of taxol, produced by the fungus, to commercial levels. [Earth Words 5(2): 9, Spring 1993].

Ecocide and genocide in Iraq

The military regime of Saddam Hussein has nearly completed a grand plan to exterminate 500,000 dissident Marsh Arabs by draining vast areas of the Mesopotamian marshland in southeastern Iraq. The 20,000 square kilometres (km^2) of marshland and reedbeds are amongst the largest in the world. The marshes shelter several million migratory waterfowl, numerous resident species including imperial and white-tailed eagles, sacred ibis, Basra reed warblers, otters, freshwater fishes, reptiles, and amphibians. Many Gulf fish spawn in the marshes. A 565 km long drainage canal, the Third River, was finished in December 1992, and a second canal, the Anfal 3, which is 70 km long, was dug along the double embankment built during the Iran-Iraq war and empties into the Euphrates near Basra. A third canal is a 50 km westward extension to Anfal 3, interrupting the hundreds of tributaries that normally spill out over the marshes. According to Dr. Hamid Al-Bayatj, London representative of the Iraqui resistance group, SCIRI, the purpose of these canals is the extermination of the Marsh Arabs and their 6,000-year-old culture; already there have been thousands of deaths. Draining the marshes would permit the military to move in with tanks and artillery; Hussein is unable to bomb the area because the marshes are in the UN no-fly zone. Donations to save the people and the marshes can be sent to: The Amar Appeal, c/o Emma Nicholson MP, House of Commons, London SW1 0AA, U.K.

Medicinal reasons for saving rain forests

A new study provides a medicinal rationale for saving tropical rain forests. A study of Michael Balick, botanist from the Institute of Economic Botany in New York, and Robert Mendelsohn, an economist from Yale University, estimates the net income derivable from the harvest of medicinal plants from the rain forests of Belize. They estimated that the asset value of land harvested for pharmaceutical products was $4,150 per hectare (ha), more than the $3,980/ha from logging and $425/hectare from farming of the cleared land. Forest plants form the basis of traditional medicine in Belize upon which 75% of the rural populations depend. Many western pharmaceuticals are also derived from tropical plants. [Wildflower, Spring 1993, p. 8].

Ottawa Biotechnology Park Established

Six years after regional government approval, an Ottawa Life Sciences Technology Park will be launched. The city is expected to commit $3.5 million for a ring road, sewers, and other infrastructure on the 43 acres of land near Smyth and Russell roads in Ottawa, Canada. This site is near the Ottawa General Hospital and other hospitals. There is space for between eight and ten buildings, which could accommodate 30-40 companies and create up to 2,000 jobs, with a possible 10,000 jobs being created in the region in the next ten years. Health care products and drugs from living organisms might be two focuses for the Park. The Park president, Louis Lamontagne has been hired, and the Ontario government has pledged $7 million to fully finance a multi-tenant building. The first building is already 30% pre-leased through informal agreements, according to Lamontagne. (The Ottawa Citizen, 29 April 1993, p. F1).

World poverty growing

According to a World Bank report, more than 1.1 billion people in developing countries earn less than US$1 per day. The number of people at that level of income grew by about 88 million between 1985 and 1990, mostly in Africa, the Middle East, Latin America, and the Caribbean (but excluding countries of the former Soviet Union). (The Ottawa Citizen, 29 April 1993, p. C3).

Whaling ban maintained

The International Whaling Commission (IWC) meeting in May maintained its ban on commercial whaling, but approval was given to kill some whales for "scientific purposes." Norway decided to defy the IWC and fix a quota of 296 for commercial purposes. Efforts to establish a whale sanctuary in the Antarctic were unsuccessful. The Britsh proposed that whale-watching could be developed to offer commercial benefits that would replace those drawn from killing whales. Whale watching is a growing tourist draw in many areas of the world; some whale watching activities may, however, disturb the whales' feeding or social activities. (The Ottawa Citizen, Sea Wind).

Mosses and liverworts endangered in Europe

Concern is increasing over the loss of species of bryophytes in Europe. The bryophytes are those plants embraced by the liverworts, hornworts, and mosses. There are some 1,500 species, quite well documented in Europe. A number of species are naturally rare, being confined to a small region—for instance, there are many endemic species on Madeira, and others restricted to a narrow habitat of gypsum-rich soils. A number of human activities are impacting bryophytes. These include forest cutting and replacement with monocultural tree plantations, and agriculture. Air pollution also affects a number of mosses. The fertilization of fields and tree plantations with nitrogen compounds further shifts the competitive balance of plants, including mosses.

Comparison of old records from museum herbaria with the results from recent surveys enable detection of changes in range or species/population losses. The general picture emerging is that 25-50% of national bryophyte flora are severely threatened. Sexual reproduction, in many cases, requires that the crossing individuals be close together, generally a few centimetres apart, for successful transfer of the spermatozoa. As populations are thinned out, then, sexual reproduction may fail and production of the spore-producing sporophyte may diminish. Multiplication of individuals and dispersal relies on the sporophyte stage.
(From H.J. During. 1992. Endangered bryophytes in Europe. Trends in Ecology and Evolution 7: 253-254.)

Conservation of Madagascar flora

On March 29, 1993, the Missouri Botanical Garden signed an agreement with Madagascar's Central Bank, allowing it to purchase up to $750,000 worth of Madagascar's international debt. It will use the funds to finance its ongoing botanical research and conservation work in collaboration with local instititutions in Madagascar.

The bank, ING bank located in Paris, holds the debt with the government of Madagascar. The Missouri Botanical Garden purchased the debt at a discounted rate of 50 cents on the dollar. The funds, up to $250,000 per year for three years, will be released to the Garden in local currency at the official exchange rate and are thus available to support the Garden's programs.

"Everybody wins in this situation," said Dr. Porter P. Lowry II, the head of the Garden's Africa and Madagascar Department. "Madagascar's Central Bank wins because part of its hard-currency debt is paid off. ING Bank wins because at least some of the money owed to them is paid. The Missouri Botanical Garden wins because the money we have available in Madagascar will go twice as far. And our Malagasy partners win because we will be able to do that much more good work together."

The Garden began working in Madagascar in 1972. Since 1983, Garden researchers have been conducting basic research and exploration of the island's poorly known flora, which is among the world's most threatened, and establishing a comprehensive data base of the plants of Madagascar. Garden botanists train and assist Malagasy botanists in modern research techniques and participate in conservation programs throughout the country. Specimens of plants are collected for the National Cancer Institute, which then screens them for possible medicinal properties. (Missouri Botanical Garden news release)

Desktop computer mapping at the National Herbarium of Canada

A recent paper describes a versatile and relatively inexpensive personal computer mapping system in use at the National Herbarium of the Canadian Museum of Nature. The system is being used to capture data on and produce maps of rare plants of Canada. The capabilities of the system are described - zooming, colour plotting, different projections, map output, preparation of colour slides from the monitor, etc. Spot distribution and shaded maps produced on the system are illustrated. Sources of latitude-longitude and place names are provided. This approach looks promising for communicating the vast amount of data in museum collections for research, conservation, environmental impacts, selection of areas for protection, locating hotspots of species diversity, and many others. [Erich Haber. 1993. Desktop computer mapping at the National Herbarium of Canada. Taxon 42: 63-70].

Biodiversity Meetings

25-27 OCTOBER 1993.
World Population—Conference of the World's Scientific Academies, to be held in New Delhi, India.

Contact: Royal Society
6 Carlton House Terrace
London SW1Y 5AG, UK
Tel: (44-71) 839-5561
Fax: (44-71) 930-2170

26-30 OCTOBER 1993.
Environmental Technology, to be held in Monterrey, Mexico. Hosted by the Munich Trade Fair. Pollution and environmental degradation are high-profile topics due to the proposed NAFTA (North American Free Trade Agreement). In addition, they are high priority topics for all countries.

Contact: TECOMEX
Münchener Messe- und Ausstellungesellschaft GmbH
Messegelände, Postfach 121009
D-8000 München 12, Germany

12-18 DECEMBER 1993.
III Congreso Latinoamericano de Herpetologicia (Third Latin-American Congress of Herpetology) will be held in Campinas, São Paulo, Brazil. Presentations and mini-courses will be in Portugese and Spanish only, lectures, posters, and workshops will accept English and French.

Contact: Commissão Organizadora 3º CLAH
Departamento de Zoologicia 1B
Universidade Estadual de Campinas
13081 Campinas, SP, Brasil

31 JULY-4 AUGUST 1994.
4th International Congress of Vertebrate Morphology, to be held in Chicago, IL, USA

Contact: Dr. Susan Herring
Chair, ICVM Organizing Committee
Dept. of Orthodontics SM-46
University of Washington
Seattle, WA 98195 USA

1993 Update
CANADIAN SPECIES AT RISK!

The 1993 Canadian Endangered Species List now stands at 236 species. The addition of species to the list was due primarily to degradation and loss of Canada's wildlife habitat. Newly listed species, such as Henslow's Sparrow, the Nova Scotia population of Blanding's Turtle, and the Wood Poppy, strongly indicate that the cherished myth of Canada as a land of endless, unspoiled terrain and sparkling clean waters no longer holds. The vast majority of species on this list—or about to be listed—depend on the preservation of critical habitat, and on the restoration of already damaged areas.

The World Wildlife Fund (WWF) in Canada is committed to the protection of critical habitats, through numerous projects, and with policy work designed to hasten the recovery of endangered populations, and to prevent the addition of new species to the list. WWF works in partnership with industry, governments, and private landowners toward these ends. Thanks to their efforts, the White Pelican and the Prairie Long-tailed Weasel have now been taken off the Canadian Endangered Species List.

1993 CANADIAN ENDANGERED SPECIES

(Changes, deletions or additions for 1993 are in italics. Pop. stands for population)

MAMMALS

Extinct

Dawson Caribou
Sea Mink

Extirpated

Atlantic Walrus
    -Northwest Atlantic Pop.
Black-footed Ferret
Gray Whale - Atlantic Pop.
Grizzly Bear - Plains Pop.
Swift Fox

Endangered

Beluga Whale
    - S.E.Baffin Is.Pop.
    - St. Lawrence R. Pop.
    - Ungava Bay Pop.
Bowhead Whale
Eastern Cougar
Peary Caribou
    - High Arctic Pop.
    - Banks Is. Pop.
Right Whale
Sea Otter
Vancouver Is. Marmot
Wolverine
    - Eastern Pop.
    (Quebec/Labrador)

Threatened

Beluga Whale
    - Eastern Hudson Bay Pop.
Harbour Porpoise
    - Western Atlantic Pop.
Humpback Whale
    - North Pacific Pop.
Peary Caribou
    - Low Arctic Pops.
Pine Marten - Nfld Pop.
Wood Bison
Woodland Caribou - Maritime Pop.

Vulnerable

Beluga Whale
    - Eastern High Arctic Pop.
Black-tailed Prairie Dog
Blue Whale
Eastern Mole
Fin Whale
Fringed Myotis
Gaspé Shrew
Grey Fox
Grizzly Bear - All other Pops.
Humpback Whale
    - Northwest Atlantic Pop.
Keen's Long-eared Bat
Pallid Bat
Plains Pocket Gopher
Polar Bear
Queen Charlotte Islands Ermine
Southern Flying Squirrel
Sowerby's Beaked Whale
Spotted Bat
Wolverine - Western Pop.
Woodland Caribou - Western Pop.

Up-Listed

- Grizzly Bear (1991)
- Peary Caribou
  - High Arctic Pop. (1991)
  - Banks Is. Pop. (1991)
- Pine Marten - Nfld. Pop. (1986)
- Polar Bear (1991)
- Wolverine - Eastern Pop. (1989)

Down-Listed

- Humpback Whale
  - Northwest Atlantic Pop. (1984)
- Wood Bison (1988)

De-Listed

- *Prairie long-tailed Weasel* (1993)

BIRDS

Extinct

- Great Auk
- Labrador Duck
- Passenger Pigeon

Extirpated

- Greater Prairie-Chicken

Endangered

- Eskimo Curlew
- Harlequin Duck - Eastern Pop.
- *Henslow's Sparrow* (1993)
- Kirtland's Warbler
- Loggerhead Shrike - Eastern Pop.
- Mountain Plover
- Peregrine Falcon
  - subspecies anatum
- Piping Plover
- Sage Thrasher
- Spotted Owl
- Whooping Crane

Threatened

- Baird's Sparrow
- Burrowing Owl
- Ferruginous Hawk
- Loggerhead Shrike - Western Pop.
- Marbled Murrelet
- Roseate Tern
- White-headed Woodpecker

Vulnerable

- *Ancient Murrelet* (1993)
- Barn Owl
- Caspian Tern
- *Cerulean Warbler* (1993)
- Cooper's Hawk
- Eastern Bluebird
- Flammulated Owl
- Great Gray Owl
- Ipswich Sparrow
- Ivory Gull
- King Rail
- Least Bittern
- Long-billed Curlew
- Louisiana Waterthrush
- Peregrine Falcon
  - subspecies pealei
  - subspecies tundrius
- Prairie Warbler
- Prothonotary Warbler
- Red-shouldered Hawk
- Ross's Gull
- Trumpeter Swan

Up-Listed

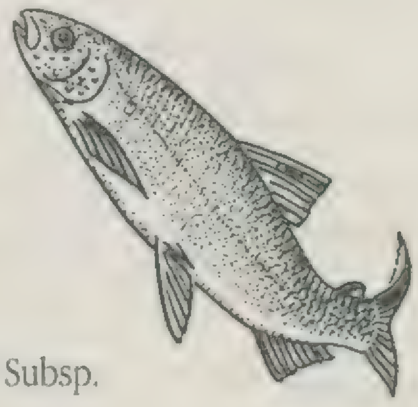
- Greater Prairie Chicken (1990)
- *Henslow's Sparrow* (1993)
- Loggerhead Shrike
  - Eastern Pop. (1991)
- Piping Plover (1985)

Down-Listed

- Peregrine Falcon
  - subspecies tundrius (1992)

De-Listed

- White Pelican (1987)



FISH

Extinct

- Blue Walleye
- Deepwater Cisco
- Longjaw Cisco
- Longnose Dace - Banff Subsp.

Extirpated

- Gravel Chub
- Paddlefish

Endangered

Acadian Whitefish
Aurora Trout
Salish Sucker

Threatened

Black Redhorse
Blackfin Cisco
Channel Darter (1993)
Copper Redhorse
Deepwater Sculpin
  - Great Lakes Pop.
Enos Lake Stickleback
Lake Whitefish - Lake Simcoe Pop.
Margined Madtom
Shorthead Sculpin
Shortjaw Cisco
Shortnose Cisco

Vulnerable

Banded Killifish - Nfld. Pop.
Bering Wolffish
Bigmouth Buffalo
Bigmouth Shiner
Black Buffalo
Blackline Prickleback
Blackstripe Topminnow
Brindled Madtom
Central Stoneroller
Charlotte Unarmoured-Stickleback
Chestnut Lamprey
Fourhorn Sculpin
- Arctic Is. Freshwater Pop.
Giant Stickleback
Green Sturgeon
Greenside Darter
Kiyi
Lake Lamprey
Northern Brook Lamprey
Orangespotted Sunfish
Pacific Sardine
Pugnose Minnow
Pugnose Shiner
Redbreast Sunfish
Redside Dace
River Redhorse
Shortnose Sturgeon
Silver Chub
Silver Shiner
Speckled Dace
Spotted Gar
Spotted Sucker
Spring Cisco
Squanga Whitefish
Umatilla Dace
White Sturgeon

Up-Listed

Gravel Chub (1987)

REPTILES & AMPHIBIANS

Extirpated

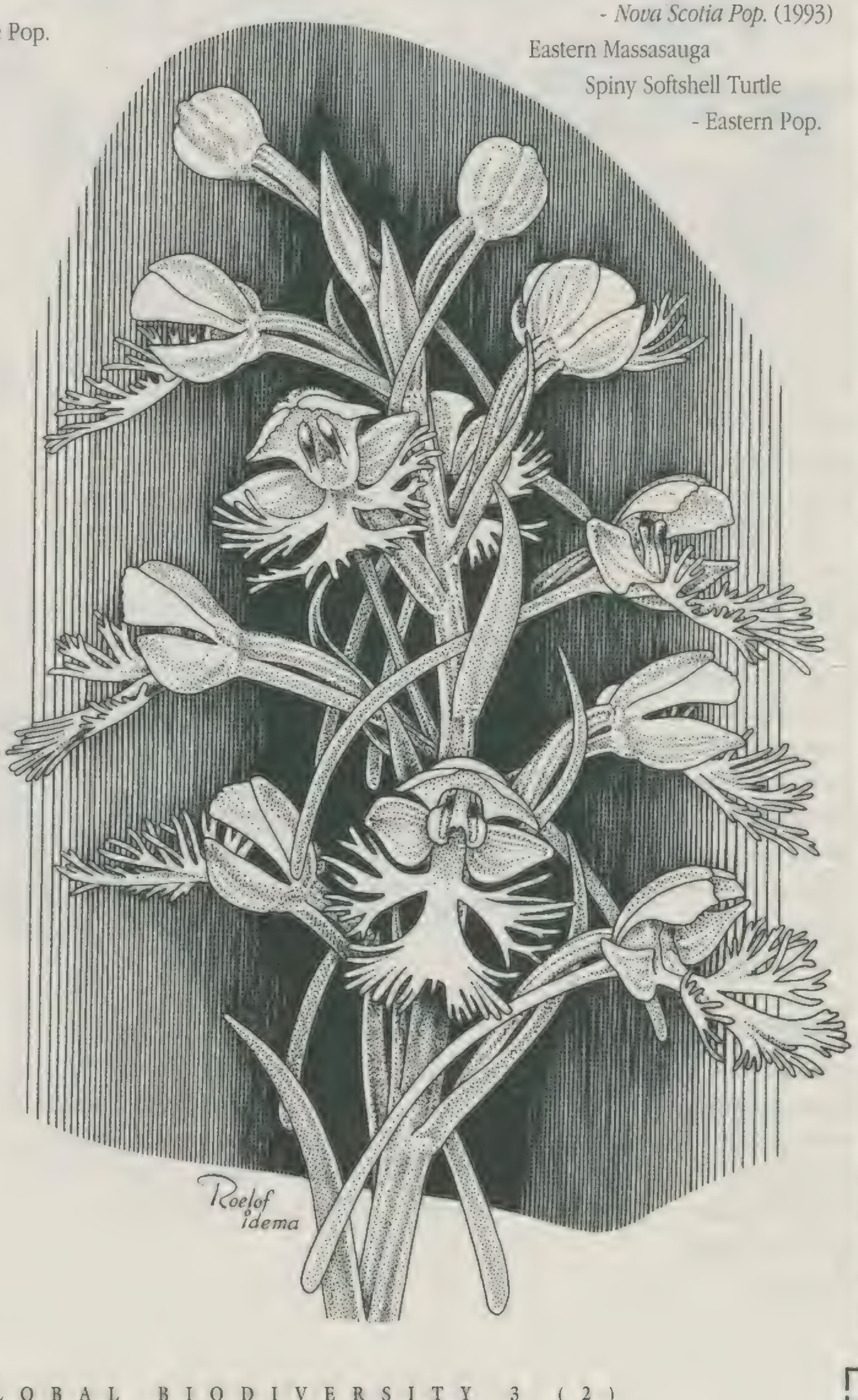
Pygmy Short-horned Lizard

Endangered

Blanchard's Cricket Frog
Blue Racer
Lake Erie Watersnake
Leatherback Turtle

Threatened

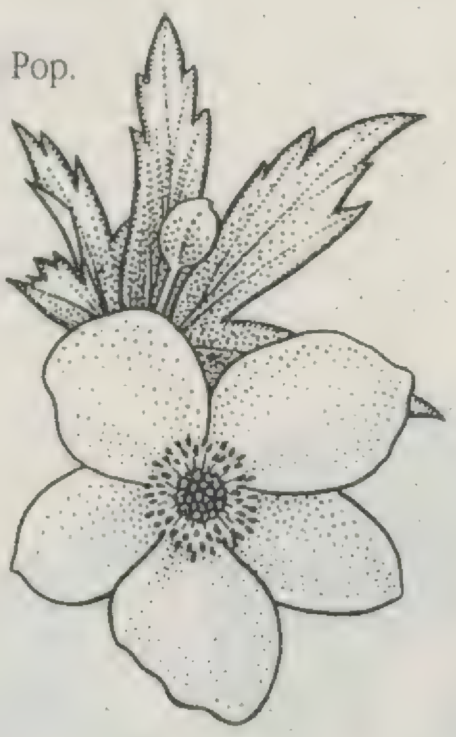
Blanding's Turtle
  - Nova Scotia Pop. (1993)
Eastern Massasauga
Spiny Softshell Turtle
  - Eastern Pop.



The Western Prairie Fringed Orchid (*Plantanthera leucophaea*) is one of eight additions to the list

Vulnerable

Eastern Short-horned Lizard
Fowler's Toad
Northern Prairie Skink
Pacific Giant Salamander
Smallmouth Salamander
Spotted Turtle
Yellowbelly Racer - Eastern Pop.



PLANTS

Extirpated

Blue-eyed Mary
Illinois Tick Trefoil

Endangered

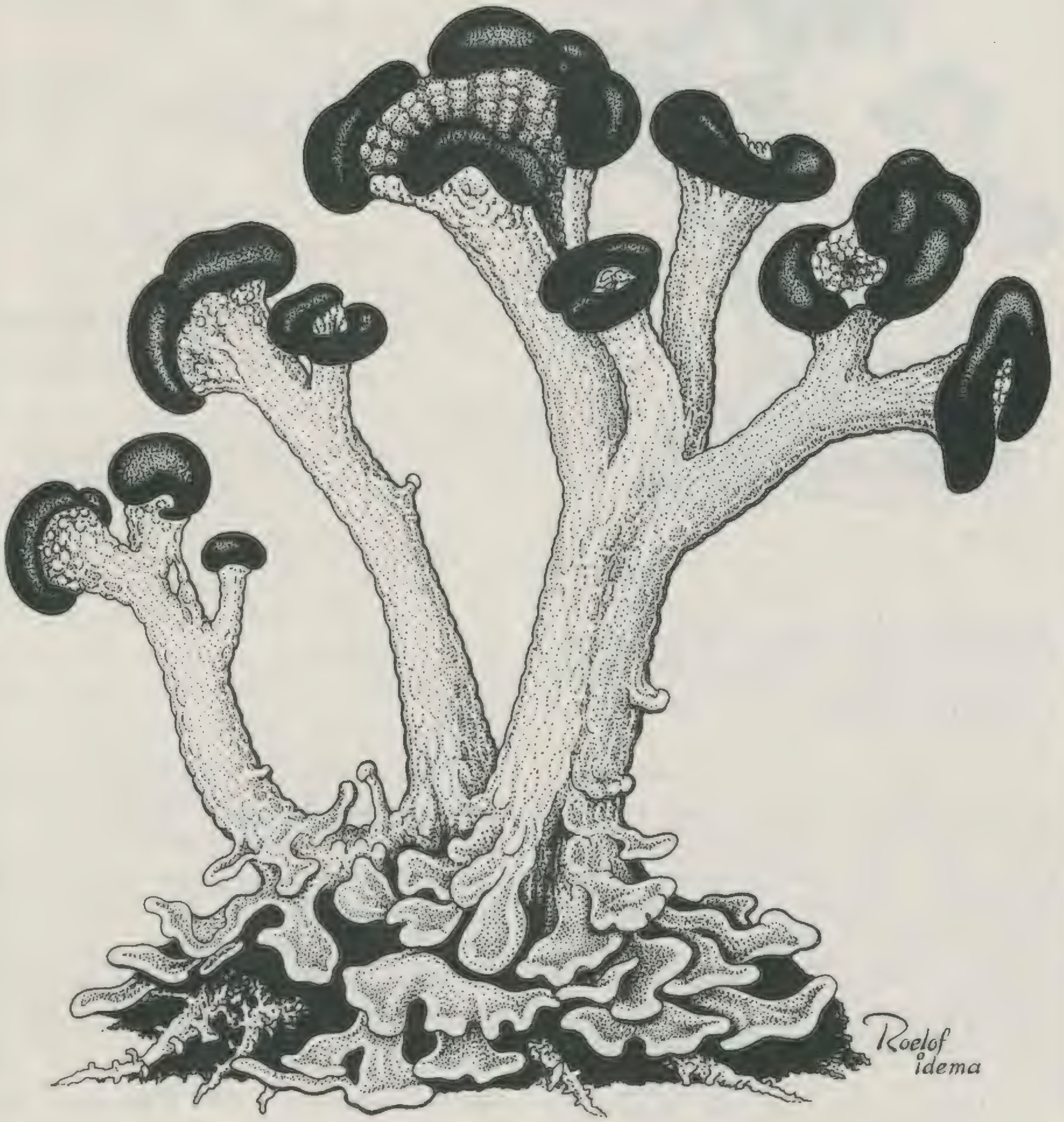
Cucumber Tree
Englemann's Quillwort
Furbish's Lousewort
Gattinger's Agalinis
Heart-leaved Plantain
Hoary Mountain Mint
Large Whorled Pogonia
Mountain Avens - Eastern Pop.
Pink Coreopsis
Pink Milkwort
Prickly Pear Cactus
  - Eastern Pop.
Skinner's Agalinis
Slender Bush Clover
Slender Mouse-ear Cress
Small White Lady's Slipper
Small Whorled Pogonia
Southern Maidenhair Fern
Spotted Wintergreen
Thread-leaved Sundew
Water-pennywort
Western Prairie Fringed Orchid (1993)
White Prairie Gentian
Wood Poppy (1993)

Threatened

American Chestnut
American Ginseng
American Water-willow
Anticosti Aster
Athabaska Thrift
Bird's Foot Violet
Blue Ash
Bluehearts
Colicroot
Giant Helleborine
Golden Crest
Golden Seal
Kentucky Coffee Tree
Mosquito Fern
Nodding Pogonia
Pitcher's Thistle
Plymouth Gentian
Purple Twayblade
Red Mulberry
Sand Verbena
Small-flowered Lipocarpha
Sweet Pepperbush
Tyrell's Willow
Western Blue Flag
Western Spiderwort

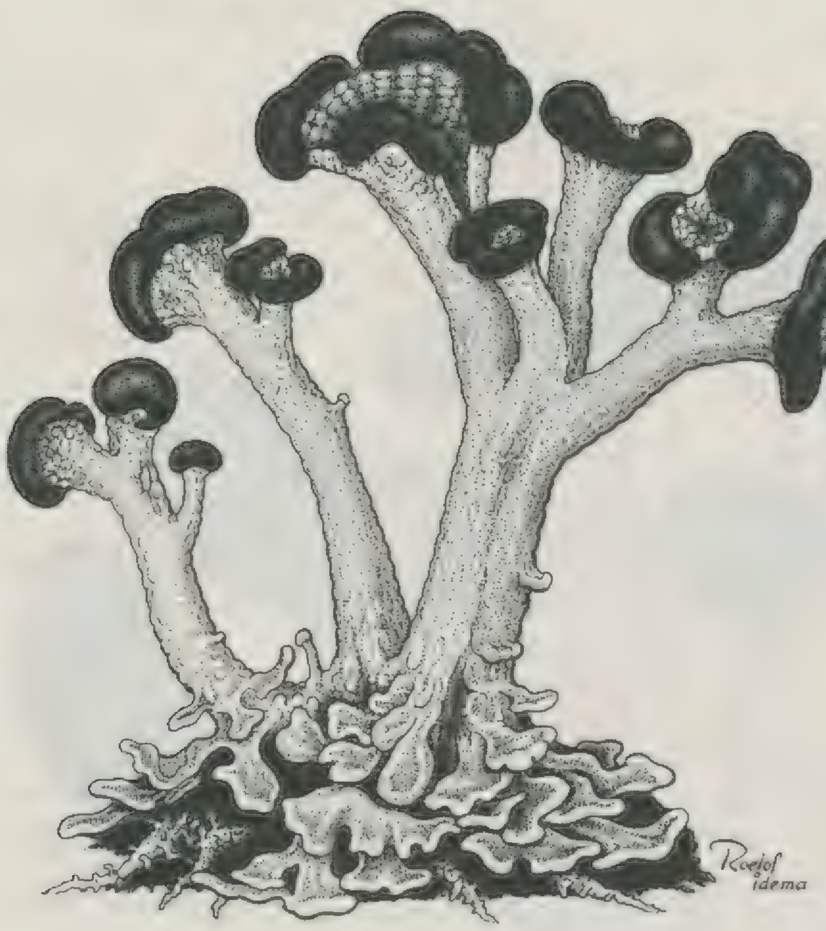
Vulnerable

American Columbo (1993)
Branched Bartonia
Bathurst Aster
Broad Beech Fern
Dense Blazing Star
Dwarf Hackberry
False Rue-anenome
Few-flowered Club-rush
Green Dragon
Gulf of St. Lawrence Aster
Hill's Pondweed
Hop Tree
Indian Plantain
Lilaeopsis
Macoun's Meadow-foam
New Jersey Rush
Phantom Orchid
Prairie Rose
Prairie White-fringed Orchid
Provancher's Fleabane
Shumard Oak
Smooth Goosefoot
Victorin's Gentian
Victorin's Water Hemlock
Western Silver-leaf Aster
Wild Hyacinth



British Soldier Lichen

Cladonia cristatella



British Soldier Lichen
Cladonia cristatella

Cladonia cristatella Tuck. is one of the most common lichens in eastern North America. Lichens are special organisms; they are a combination of two entirely different groups, a fungus and a green alga. The two components grow together in a harmonious association referred to as a symbiosis or mutually beneficial union. The globular scarlet fruiting bodies of this lichen species are the basis for its popular names, the British Soldier Lichen, Polish Soldier Lichen, or the Red Crest Lichen. There are other red-fruited lichens, but almost all seen during a day's search in Eastern North America will belong to this species. In Western North America and in Europe this species is unknown, its place being taken by *Cladonia bellidiflora*. The fruits are sometimes maroon, black, orange, buff, or white coloured.

This lichen is commonly found on the ground, tree bark, dead wood, fences and sometimes stones or amongst mosses. The greenish-grey or straw-yellow stalks are commonly one to two cm high, rod-like or branched like a small tree.

This lichen reproduces both sexually and asexually. Sexual reproduction is a function of spore production by the fungus, not the composite thallus (the combined structure of the lichen and the algae). Once a fungal spore germinates, it then combines with a suitable alga to become lichenized. Asexual reproduction is done by the entire thallus. Specialized structures on the base of the thallus and other fragments break off and regenerate to reproduce the lichen.

Lichens are disappearing because of human activities. Some of these species are characteristic of rich, undisturbed, old forests that are themselves disappearing. The drying of land due to farming also decreases habitat. Air pollution is toxic to lichens; most are extremely sensitive to sulphur dioxide, heavy metals, and nitrous oxide.

Book and Periodical Niche

Biodiversity research in museums: A return to basics

By Edward H. Miller. 1993. In: Our living legacy: Proceedings of a symposium on biological diversity. Royal British Columbia Museum, Victoria, B.C.

Museum collections of biological specimens are the fundamental reference material that documents the world's biological diversity. They are essential, also, for identification purposes, invaluable in education programs, and necessary for countless investigations in environmental biology, ecology, evolution, and other fields. Museum collections need to grow and diversify rapidly because of the accelerating loss of the world's species and habitats. Collection growth should be based on:
(a) biological inventories of threatened and disappearing habitats;
(b) opportunistic aquisition of specimens of rare or endangered kinds of animals and plants;
(c) voucher specimens from biological surveys; and
(d) diversification, including frozen-tissue collections and audio-visual archives. Museum collecting and research must emphasize poorly known and diverse groups of organisms, as well as groups that are ecologically important and have high scientific, cultural, and aesthetic value.

Museums are the major contributors to the science of systematics, which embraces classification, taxonomy, evolutionary relationships, and evolutionary processes. Basic systematics research and training are declining seriously. It needs to be increased, and museums should take the lead in doing so. Museums also need to educate non-systematic biologists and the general public about the essential role of systematics in the study of biological diversity and in conservation biology generally. [Author's abstract].

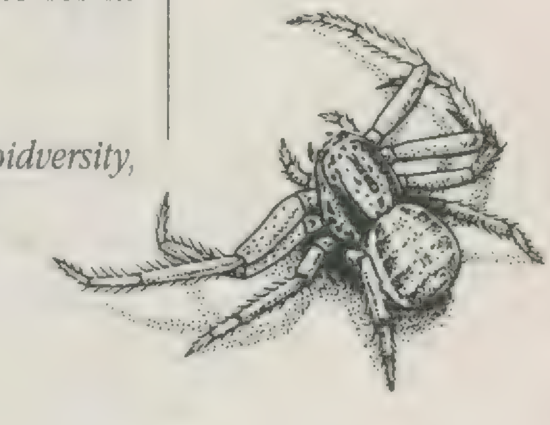
Traditional Ecological Knowledge. Concepts and cases.

Edited by Julian T. Inglis. International Program on Traditional Ecological Knowledge, Canadian Museum of Nature and International Development Research Centre (IDRC). 142 pp., illus. Paper, ISBN 0-88936-683-7, Can$19.95 (including postage and taxes) from IDRC, P.O. Box 8500, Ottawa, Ontario K1G 3H9, Canada.

I give this book just a brief notice because it arrived right before press time, and there was not time for a full review. A full review will come in a later issue, but in the meantime, I wanted to bring it to readers' attention. As many know, there is a rapidly growing interest in traditional ecological knowledge (TEK) and its pertinence to success in Agenda 21 and to ecologically sustainable development. The papers in this volume were selected from special sessions on TEK held during the Common Property Conference at the second annual meeting of the International Association for the Study of Common Property, attended by indigenous peoples and specialists, some internationally reknowned, in the subject from around the world.

Papers in Concepts and Cases, include the following topics: community-based resource management, transmission of TEK, integrating TEK with environmental impact assessment, the legal system and collective wisdom, African TEK and sustainable development, native land use and common property, and many others. This is an excellent collection, which shows the diversity of traditional knowledge, and elucidates its many social, environmental, spiritual, and economic values. The International Program on Traditional Ecological Knowledge at the Canadian Museum of Nature is to be congratulated on its first publication, and IDRC for its support of this project.

Don E. McAllister, Canadian Centre for Bioidversity, Canadian Museum of Nature, Ottawa, Canada.



Cumulative Environmental Effects Bulletin

Published jointly by Environment Canada and the Federal Environmental Assessment Review Office (FEARO). Contact: Carmen Drouin, CEE Bulletin, FEARO, Fontaine Building, 14th Floor, 200 Sacré-Coeur Blvd., Hull, Québec K1A 0H3, Tel: (819) 953-8591, Fax: 994-1469 or: Ted Moenig, CEE Bulletin, Environment Canada, Place Vincent Massey, 9th Floor, 351 St-Joseph Blvd., Hull, Québec K1A 0H3, Tel: (819) 953-1524, Fax: 953-4093.

There are a number of issues concerning cumulative effects on the environment that deserve attention in Canada. These include the impacts of ocean trawlers on target and non-target species biodiversity and on benthic habitat, and the effects of mixtures of numerous toxic subtances on aquatic ecosystems and species. Do these effects add up, multiply, or accumulate? Are pesticides and chemical fertilizers cumulative and synergistic in their effects on the natural fauna, flora, and microorganisms in soil? Are the effects of industrial logging (clearcutting, pesticide spraying, replanting of reduced numbers of trees species) cumulative on the biodiversity of the smaller species that inhabit forest soils, the soil surface, the tree branches, and the canopy, as well as on forest soil horizons and their organic content?

The literature on effects of chemical mixtures on organisms and ecosystems is much smaller than that of single chemicals on single species. Obviously one-on-one chemical and species tests are easier to carry out in the lab, but in the real world, multiple chemicals and species are the norm. Just as conservation is moving from single species to ecosystems and to hot spots, environmental impacts are now beginning to examine the effects of persistent, combined, and multiple stresses on environments and biodiversity.

The first four-page issue of the Cumulative Environmental Effects Bulletin (CEEB) was issued in March 1993. Its purpose is to report on experiences and initiatives related to the assessment of cumulative environmental effects. Cumulative effects are those environmental effects resulting from the interaction, combination, and compounding of impacts associated with one or more activities. These impacts may occur over time and space, gradually altering the structure and functioning of biophysical systems. Slow degradation is often overlooked, but the cumulative effects for the world may be worse than one-time events like oil spills.

The first issue lists cumulative effects initiatives. These include the Hudson Bay Program of the Canadian Arctic Resources Committee, the Rawson Academy of Aquatic Science, and the Environmental Academy of Sanikiluaq, the three of which will examine the cumulative effects of the several Hudson and James Bay basin hydroelectric projects; a Workshop on Cumulative Environmental Effects for EA Administrators that was organized by the Ontario Ministry of the Environment and FEARO in November 1992; and a FEARO reference guide on cumulative effects.

FEARO and Environment Canada are to be congratulated in starting this new bulletin. It fills a real need. I hope that it will resist pressures to dilute findings and points of view. For the moment there is no subscription fee and it is expected to be issued three or four times a year. An ISSN number has not yet been issued. The title of the French language edition is: *Bulletin sur les effets environnementaux cumulatifs.*

Don E. McAllister, Canadian Centre for Biodiversity, Canadian Museum of Nature, Ottawa, Ontario, Canada.

The Ultimate Resource

By Julian L. Simon, 1981, Princeton University Press, Princeton, New Jersey, 415 pp., ISBN 0-691-00369-6, paperback, US$24.95.

The author informs us that this book originated through an interest in the economics of population. It was written more than ten years ago, so that much of its value lies in the accuracy of its predictions. Some have not been fulfilled, such as the use of nuclear fusion as a source of energy and the mining of the moon—both of which were predicted to begin in the 1990s. However, it also predicted that the price of many basic commodities (i.e. copper, iron, lead, aluminum, wheat, coal, oil, and electricity) relative to wages would continue to fall in the future. This led to a famous wager between Paul Ehrlich, who predicted that increases would occur in such commodities during the decade 1980-1990, and the author. Ehrlich lost the wager and paid Simon the $1,000 due him (New York Times Magazine, 2 December 1990).

The basis of Simon's methodology (p. 48) is that science is derived from empirical observations, and is not definitional in nature. He observes that the incidence of famine and pollution have also diminished, and concludes that "The Ultimate Resource" of our species is its creative imagination and biologically unusual ability to reason. Many in the conservation movement would surely agree with the latter; Simon further subscribes to the view that birth control and abortion are valid means for individuals (not governments) to regulate natality. However, the text is written in the conviction that most conservationists are hostile to the author's findings—surely not an optimistic conclusion regarding the ability of the participants in this debate to submit their hypotheses to the unusual ability of our species to reason! Indeed, if society's intellectual leadership were unable to follow the conventions of fair-minded debate, it would negate the primary tenet of the volume

This reviewer hopes that Simon's arguments will be carefully evaluated by his peers. The book contains many interesting lines of thought, and will be useful in stimulating research on the position of our species in nature. Princeton University Press will soon publish a second edition; the first has gone through five printings and continues to sell well.

Dale A. Russell, Research Scientist,
Canadian Museum of Nature, Ottawa, Ontario, Canada

The New Organic Grower

A master's manual of tools and techniques for the home and market gardener.
By Eliot Coleman. 1989. Old Bridge Press, Camden East, Ontario, Canada. 269 pp., illus. Paperback, ISBN 0-921820-10-0, Can$19.95.

Over ten per cent of the land area on Earth is used for the farming of crops; over twice that much is used for rangeland. On each farm plot many species are replaced with one or only a few species, although farm hedge rows and woodlots may serve as corridors or refuges. Eroding soil and pesticides applied on farmland may by carried by runoff to degrade river or ocean habitat, or the pesticides may be transported thousands of miles by global air currents. How we farm the Earth can have impacts on biodiversity far beyond the limits of the ten per cent of the planet's land surface that is taken up by farms.

This is a book for market gardeners or small farmers who work between 2.5 and 6.25 hectares, but many of the principles and ideas can be used in the home vegetable garden. The author succinctly explains how organic farming works, which plants grow best together, what green manure to use for the crop that is to follow, etc.

In one chapter Eliot Coleman describes the ideal land: what to look for when buying a property, type of soil, slope, drainage, wind protection, water access, possible pollution sources, etc. At the end of the chapter he confesses that he has never found the ideal! But even with less, much can be done - planting windbreaks, and improving soil and drainage.

Coleman is a great advocate for small-scale, regional production: it is good economics as well as environmentally-friendly. Less distance to the market means fresher produce. There is no need for large expensive machinery. Growth and change does not necessarily mean bigger; it should mean better quality and more variety. In his chapter on marketing he stresses better quality, such as real, better-tasting, ripe tomatoes; also, how to plan for the local market; how much to plant of major and minor crops. Then, there is a discussion on the benefits of crop rotations, which means variety and gives biological stability. The longer the rotation, the better. Each crop takes different nutrients from the soil, all may affect the following crop. For example, potatoes yield best after corn, but a prior crop of peas increases production even more. Root crops are often detrimental to the crops that follow, but not to beans. There are examples of multi-year rotations with explanations of why and how.

There are chapters on green manures and undersowing: which green manures work best for which crops, instructions on how to build up the soil and to maintain it in good condition, seeding, transplanting, soil blocks, season extension with coldframes, low covers or green houses, weed and pest control, which is much improved by crop rotation. There is a whole chapter on deep tillage, and shallow tillage, plus equipment. For each chapter he describes the best tools for that particular aspect of the farm. He also mentions the advantage of livestock, a few chickens, a cow, some sheep, not for profit, but for free manure or insect and weed control and free eggs.

An appendix of recommmended tools and supplies with manufacturers for each chapter in the book and an appendix of major vegetable crops are found at the end of the book.

Although the book is meant for market gardeners, much is of interest for the home vegetable grower. One, obviously, cannot have a ten-year crop rotation in the back yard, but it is good to know which crops will respond well to a previous one. Also, sowing a green manure under the corn is worthwhile, and perhaps a few chickens could eat the slugs and caterpillars (where bylaws permit this).

The New Organic Grower is a clearly written book full of information from which much is to be learned, and I love the illustrations by Sheri Amsel! Coleman wrote his book from personal experience: he has been an organic farmer for more than 20 years, and is now the farm manager of the Mountain School Program of Milton Academy in Vershire, Vermont. He is also garden tool consultant for Smith & Hawkin.

Elisabeth Janssen, 2883 Otterson Drive, Ottawa, Ontario, Canada

On Common Ground: Managing Human-Planet Relationships.

by Ranjit Kumar, Barbara Murck. 1992. John Wiley & Sons Canada, Rexdale, Ontario. 216 pp., hardcover, Cdn $24.95. ISBN 0-471-64040-9.

Earth's ecological problems will not be solved by calls for global good will. The present volume approaches them with non-Darwinian biology and simplistic politics. It seems to be the flagship of a "Project Learning" in Toronto, and it suggests that the sponsoring "Foundation for International Training" still has a lot to learn.

Here is the familiar refrain of environmental abuse and reform, but in comparison with WorldWatch Institute efforts in the genre, this book suffers from loose language and lacks a definite vision of a reformed world. The introductory sections are rough reading, and would have deterred me from continuing had it not been a review volume. The reader is jerked about with a televisionlike suddenness, quotes appear at random without citation of source in the text (though there are endnotes), there are grating redundancies and sorry attempts at cuteness, and the discussion jumps back and forth among economic, anthropocentric, ecological, and intrinsic systems of values. The book's square shape, floppy curling covers, long lines of text with narrow margins, and ugly diagrammatic drawings contribute to the difficulty of reading it. There is no index.

Two overblown sentences (p. 67) summarize the book's message and style: "Human actions, and the public and corporate policies governing these actions, engender environmental consequences. If we can identify specific levels of control and responsibility for these actions and policies and find appropriate administrative structures through which to work, then we can begin the essential task of formulating environmentally sustainable policies."

"Climatological characteristics" for 'climate' (p. 131), and "scientists believe" for 'meteorologists accept the hypothesis' (p. 140) are examples of the loose style. "System" and "cycle" are used throughout for processes which are not demonstrably organized or cyclic; "wildlife," "consumption," and "produce" (of oil) are used in conventional senses that the ideological message of the book would condemn, and jargon like "anthropogenic" and "fixed carbon" are used without definition.

The authors construct a world ecology without natural selection, "designed so that subsystems take care of most of their own needs and purposes, yet simultaneously serve the needs of the larger aggregate system" (p. 25). Their politics is a careless first person plural: they assume that the Earth is a "system" and that "we" "manage" it. There is no final vision of reforms that may be necessary except more responsive government and more education: no world population policy (such as one-child families, free international migration), no energy policy (such as photovoltaic roofing), and no economic policy except an indirect three-paragraph proposal for the abandonment of capitalism (p. 29).

On the other hand, this is a good summary of the environmentalist view of 'human-planet relationships,' and the factual errors I noticed, while profound (e.g., "empty ecological niches are quickly filled," p. 31; "no soils form in situ", p. 108), do not affect the argument. An ecologically sustainable human society is indeed the fervent desire of all reasonable people. Perhaps this book can convince some urban television-eaters or Third-World dictators that ecological issues are important, and I am just too far removed from their state of mind to recognize its effectiveness.

Frederick W. Schueler, Herpetology Section, Canadian Museum of Nature, Ottawa, Ontario, Canada

Proceedings of the workshop on systematics.

University of Ottawa, 16-17 June 1992. Edited by P. Marriage. Agriculture Canada, Research Branch, 1992. 73 pp. Copies of this document are available from Dr. Paul Marriage, CLBRR, Research Branch, Agriculture Canada, Ottawa, ON. K1A 0C6, CANADA.

As in most countries throughout the world, support for basic systematics work is declining in Canada. In June 1992, a two-day workshop was convened on the initiative of Agriculture Canada, primarily as a means of responding to a 1990 review of the activities of the Biosystematics Research Centre. The Centre is the primary centre for entomological, and to a lesser extent, botanical systematics work in Canada. In reality, however, the workshop served a much broader function, that of outlining the major implications of this declining support and of addressing how the systematics community in the federal government should resolve these problems. This publication reports the proceedings of this workshop.

The workshop started with introductory statements outlining the problems and current state of affairs being presented by representatives of the three major participating institutions, Agriculture Canada, Forestry Canada, and the Canadian Museum of Nature. These introductions set the stage for the activities and discussions to follow. These activities focused on three major themes: research, collections, and services (including education). Workshop participants were assigned to one of three groups, each dealing with one of these themes, and the subject was discussed. For each theme, an overview was presented, and the working group discussed issues and problems, then formulated a series of recommendations for presentation and discussion at a plenary session. These overviews, recommendations, and a summary of the plenary discussions are published herein for each theme. The document concludes with an overview of the problems generally facing systematics in Canada and the conclusions of the workshop participants about how these problems could or should be addressed.

Although the workshop addressed the systematics crisis largely from a federal-government perspective, the problems discussed are not restricted to those working in federal agencies and, in fact, should be of concern to every Canadian. Anyone interested in the current challenges facing systematics research and collections, in particular, should read this publication. It doesn't solve the problems, but it outlines and initiates valuable steps toward reaching the goal of preserving such research.

Robert S. Anderson, Canadian Museum of Nature, Ottawa, Ontario, Canada

Saskatchewan Global Education Project Resource Catalogue

by D. Glaze (ed.), Saskatchewan Global Education Project, 1992, Box 1108, Saskatoon, Saskatchewan S7K 3N3, Telephone 306-373-1660.

The Saskatchewan Global Education Project is funded by the Canadian International Development Agency (CIDA) and is a consortium of several Saskatchewan educational institutions; however, the resource information provided within is not limited to Saskatchewan alone.

As a reference guide on Global Education for all educators of primary and secondary education, this catalogue contains approximately 400 resource materials available within Canada, (several U.S. and Australian items are presented as well). Instructions include where to obtain items, either to purchase or borrow, contacts for educator workshops, and a resource base of speakers and workshop leaders for professional development planners.

Fourteen categories of resource information include Global Education, Cross-cultural/Multiculture Education, Development Education, Environmental Education, Futures Education, Gender Equity, Health Education, Human Rights Education, Media Literacy, Peace Education, Computer Networking, Global Days, Student Exchanges and Twinnings, and Teacher Exchange and Short-Term Service. Also included are three appendices of addresses for provincial non-government organizations (NGOs), Publishers and Distributors, and Magazines. A brief annotation is provided for each material listed, including suggested grade level, cost, description, distributor, date published, and author.

Noting that the Canadian Museum of Nature is not listed as a publisher nor some of its publications, it was good to see a half page set aside by the Project Group for recommended updates and new material listings.

Simply stated, the basic idea of the catalogue is "that to

sustain our world we will need to understand its parts and how they fit." The Saskatchewan Global Education Project has attempted to provide in one catalogue a basis for information to teach global relationships between the planet and humanity and how and where to take the first step.

Susan A. Jarzen, Volunteer in Paleobiology, Canadian Museum of Nature, Ottawa, Ontario, Canada

Guide to the natural history of the Niagara region

J.C. Lewis, editor. Cam Lewis Enterprises, St. Catharines, Ontario. 1991. 447 pp. Paper. Can$26.00; US$22.00; Intl: Can$27.00 (taxes, shipping and handling included). ISBN 0-9695784-0-7.

This volume, a combination natural history guide and biology text, begins with maps and a brief discussion of conservation areas in the Niagara Peninsula of southwestern Ontario. Then 26 chapters of variable scope and depth follow and range from the geology of the region to a half-page on gastrotrichs. The editor, a biology professor at Brock University, authored and co-authored 18 of the chapters.

The book gives approximately 90 pages to the geology, invertebrate paleontology, and archaeology of the Niagara region, with enough illustrations, maps and stratigraphic sections to serve the reader as a good field guide. There is no mention, however, of the vertebrate fossils that have been found in the peninsula, including, for example, several skeletons of the American mastodon. As a whole, the biological chapters are highly variable in content. Some have keys, most have descriptions, a few have illustrations, but only a few have regional checklists or are tailored to the fauna and flora of the region. Useful treatments include chapters on mammals, birds, amphibians and reptiles, fish, protozoa, mollusks, insects (at 76 pages, the longest chapter), ferns, vascular plants, and trees. The maps and illustrations by Cathy Wesol are excellent and informative.

Overall, the book succeeds in demonstrating that the Niagara Peninsula is a unique and complex place with an interesting geological and human history, inhabited by a diversity of life forms often at the fringes of biotic or climatic zones. Future editions would be improved by omitting chapters or sections that present little more than the biology of microscopic organisms, by including chapters on algae, mosses, lichens, arachnids, and nematodes, and as the editor notes, by improving the cursory treatment given some important groups such as fungi, grasses, wild flowers, and shrubs. The bibliography includes good general field guides and references, but omits some useful standard works such as F.R. Cook's *Introduction to Canadian Amphibians and Reptiles* (1984), W.E.Godfrey's *The Birds of Canada* (1986), and R.T. Allen's *The Great Lakes* (1970). The inconsistent form and editorial lapses detract from a generally useful compilation and sourcebook on this interesting region.

Stephen L. Cumbaa, Research, Paleobiology, Canadian Museum of Nature, Ottawa, Ontario, Canada.

The Tiny Perfect Dinosaur Book, Bones, Egg and Poster: PRESENTING TYRANNOSAURUS REX

John Acorn with Dale Russell, illustrated by Ely Kish. 1993. Co-produced by Somerville House Publishing and Canadian Museum of Nature. Distributed by Thomas Allen and Son Limited, 390 Steelcase Rd. East, Markham, Ontario, CANADA L3R 1G2. 32 pp. Paperback, ISBN 0-921051-82-4. CAN $13.95.

Long before *Jurassic Park* was written, let alone filmed, the Canadian Museum of Nature knew the importance of dinosaur research and also, the immense attraction these long ago creatures have for us today. To celebrate dinosaurs in a new and special way, the Museum has named October 1993 Dinosaur Month. To complement its already popular dinosaur gallery, a first-ever display of Ely Kish's renowned dinosaur paintings, many special events, and a 1-800 DINO information line are planned. Not least among the events will be the launch of a brand new book for young readers on dinosaurs: *The Tiny Perfect Dinosaur Book, Bones, Egg and Poster: Presenting Tyrannosaurus rex.*

The second in a series (the first dinosaur package focused on *Leptoceratops*), this package contains exactly what its title suggests. The small, easy-to-hold, 32-page book is full of lively illustrations. Each picture contains a wealth of information that is backed up by a simple, informative text written by John Acorn in consultation with Dale Russell of the Canadian Museum of Nature. Both text and artwork examine *Tyrannosaurus* in detail—its body, its habits, and the world in which it

lived. One third of the book is devoted to placing *Tyrannosaurus* in context, both historically and physically, and so readers discover that its world was filled with a diverse lot of plants and creatures, not all of them dinosaurs. In a subtle way, this book shows young people that a rich variety of life has always existed and, in fact, existed for eons before people evolved.

The egg is made of solid, durable plastic, and children will delight in opening it to discover the precious bones that lie inside. Then, putting the paleontologist inside them to work, children will surely enjoy assembling the skeleton. The skeleton is an exact replica of the very first *Tyrannosaurus* skeleton discovered by Barnum Brown in 1902—reduced in size, of course.

The poster acts as a backdrop giving the reader a three-dimensional context in which to make *Tyrannosaurus* roar once again. All in all, a quality package full of information and surprises about the world as it once was.

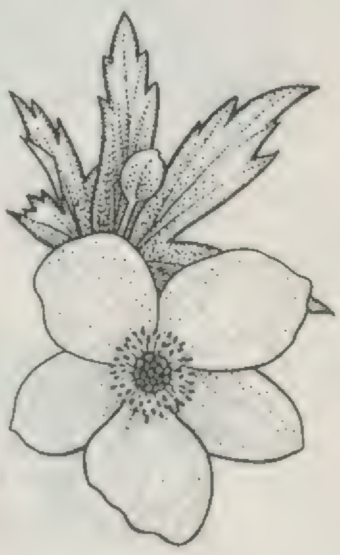
Catherine Ripley, Managing Editor, Global biodiversity, Canadian Museum of Nature, Ottawa, Ontario, Canada.

Workplace Guide: Practical Action for the Environment

M. Bloomfield and L. Warde-Whate (editors). 1991. Harmony Foundation of Canada, Ottawa. 170 pp. ISBN 0-929010-04-3. CAN$37.45.

The Workplace Guide is a truly useful publication aimed at providing insights into all aspects of an organization's operations that may require actions to minimize environmental impact. The information presented is applicable to a wide spectrum of workplaces from commercial office towers, hospitals, and shopping malls to corner stores and home businesses.

The main topics covered for environmental audits and corrective action include energy, hazardous materials, waste, water, transportation, purchasing, and property management. These subjects are all treated in a similar and consistent format for ease of finding relevant information. Each chapter on the above topics begins with a "quick start" section that serves as an index and highlights the most important actions that can be implemented immediately. Next follows an introduction that points out the effect on the environment and the cost to the organization of wasteful practices. Then comes a section dealing with target areas and actions,



and finally, each chapter finishes with success stories of organizations that have taken various initiatives, which have been beneficial to the environment and to the organization, economically.

The Workplace Guide serves not only to help all individuals in a workplace, from senior management to concerned staff, organize themselves to do an environmental audit and take appropriate action, but also serves as a resource book on environmental facts and organizations and programmes that can be tapped for assistance. Environmental facts and supplementary information and ideas on appropriate actions are presented in sidebars or as footnotes that help justify why certain corrective procedures should be taken and indicates the benefits to be gained. The footnotes are referenced to source documentation.

The importance of team work and the need for education at the workplace is also stressed in the *Guide.* It is only through awareness of the facts and the consequences of action or inaction that success will come to a workplace program aimed at environmental and resource conservation.

The *Workplace Guide* is written from a Canadian perspective and for Canadian businesses and organizations. Virtually all of the success stories deal with Canadian examples, and the references to sources of supplementary information in each chapter are arranged by federal and provincial listings. Yet, although written for Canadian businesses, the basic facts presented and workplace assessment worksheets and action planners included are universally applicable.

Erich Haber, Botany, Canadian Museum of Nature, Ottawa, Ontario, Canada

Rainforests of the World

by Mary McLean. 1991. Scientific Artwork Company, Celestial Arts, P.O. Box 7327, Berkeley, California 94707. 16 pp. ISBN 0-89087-673-8. Current poster prices unknown.

The Jane Goodall Institute for Wildlife Research, Education and Conservation has sponsored the production of a series of four posters with accompanying text on the Neotropical, Northwest Coast, African, and Southeast Asian rain forests. The text written by McLean supplements the beautiful colour artwork by Earl Bateman, and together they provide a visual and textual presentation of the four major rain-forest ecosystems of the world. The information presented, both graphic and written, appears up to date, stressing the fragility, diversity, and nature of each rain-forest system. Information is provided on how the reader may help preserve our rain forests. Addresses are given for environmental and wildlife organizations that may provide additional information. The posters are suitable for framing and provide an impressive form of artwork, which attracts much attention and comment. Each poster and text focuses on a different aspect of biodiversity: The Neotropical poster considers biodiversity in general terms; the Northwest Coast poster centres on ecosystem diversity; the Southeast Asian poster, on the multi-layered structure of a rainforest; and the African poster, genetic diversity. The posters and text are an excellent resource for schools and community conservation groups, or as gifts for the naturalist or Eco-Activist.

David M. Jarzen, Paleobiology, Canadian Museum of Nature, Ottawa, Ontario, Canada

Freshwater fish. Canadian Nature Guide.

By Henry W. Robinson. 1992. Smithmark Publishers Inc., 112 Madison Avenue, New York. 192 pp., color illus. ISBN 0-8317-6968-8. Can$9.95.

The publication series name, *Canadian Nature Guide,* under which this book is published is deceptive. It is a guide to American and Canadian species of fishes, not just Canadian. The author is American. It was published in New York. The illustrations were apparently done in London, U.K. The hurried purchaser may not notice the statements on the back and inside wrapper that it illustrates representative North American freshwater fishes; even that is misleading as Mexican endemic species are omitted. While flipping through the pages at the book store, the naturalist and angler will probably not notice that over 100 of the 307 species included are exclusively American. Checking with *Books in Print* reveals that there was a simultaneously published edition, with the same ISBN number, but under an American Nature Guide series.

A truly Canadian nature guide deals only with Canadian species, the characteristics and distribution of Canadian populations of those species. Such a guide is easier to use than one that includes both American and Canadian species because the reader does not have to eliminate from identification the numerous species that occur only to the south. This provides more space for information on Canadian species.

This does not mean that Canadians are unwilling to purchase nature guides openly marketed as including both Canadian and American species, especially when they are of good quality and there is no exclusively Canadian guide. Peterson, Golden, and other guide series that cover biota of both countries have sold quite well in Canada, even though their Canadian coverage is frequently less thorough. At least those publishers do not deceive buyers with a Canadian edition rubric.

Flipping through the book gives the impression of a variety of superficially pleasing colour paintings of fishes. But upon more careful examination of the illustrations, there are flaws. Several give the impression that the artist has never seen a live specimen, the drawings of some were contorted as in a pickled specimen. The diagnostic dark spot in the first dorsal fin of the prickly sculpin, *Cottus asper*, is not shown. The characteristically, sharply defined dark saddles on the torrent sculpin's (*Cottus rhotheus*) back, are not depicted. Exclusively Canadian species such as the Acadian whitefish, *Coregonus huntsmani*, are omitted, as are the least and Arctic ciscos, common in the Arctic. French common names are omitted.

Despite the low price of this colour guide, I do not recommend it to either Canadian or American readers.

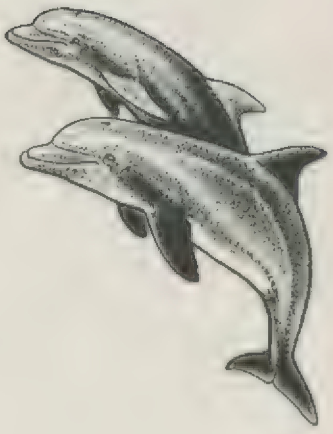
Don E. McAllister, Canadian Centre for Biodiversity, Canadian Museum of Nature, Ottawa, Canada.

Conservation of Biodiversity for Sustainable Development

Edited by O.T. Sandlund, K. Hindar and A.H.D. Brown. 1992. Scandanavian University Press, Oslo. 324 pp. with index.

One approaches, with some degree of trepidation, any book that manages to fit into its title two of the hottest state-of-the-art buzzwords around. However, reader, fear not! Your courage will be well rewarded by the richness, scope, and pertinency of this volume.

The book publishes papers from the "International Conference for the Conservation of Genetic Resources for Sustainable Development," which was organized by the Norwegian Institute for Nature Research in 1990. The broad subject area attracted a fascinating mix of contributors ranging from conservationists such as Michael Soule and Philip Hendrick, to crop genetic resource scientists like Tony Brown and Sting Blixt, and extending to well-known social activists Vandana Shiva and Cary Fowler.



The 20 invited papers were chosen with a view to presenting not only the "scientific know-how" but also the "social and political framework." The volume presents the essays in seven sections, each introduced by a short, enticing foreword. The first six parts are entitled "Biodiversity," "Genetic Resources and Conservation Biology," "The Ecological Context of Genetic Erosion," "Strategies for Ex Situ Conservation," "Biotechnological Challenges," and "Biodiversity and Sustainable Development."

It is likely that readers will appreciate, as I did, the opportunity to read informed reviews about biodiversity in fields with which they are less familiar. The choice is wide, and includes the management of tropical biodiversity by INBio in Costa Rica in which the role of parataxonomists and the philosophy of "use it (i.e. biodiversity) or lose it" is discussed. Other topics include a case study of sociological and political constraints to biodiversity conservation in India, the effects of climatic change on biological diversity, ex situ conservation of animals (livestock, salmon, and zoos) and plants (crop genebanks and botanical gardens), and several perspectives on population genetic structure and ecological genetics in biological conservation.

What is missing from the book? Paradoxically, in light of the title, discussion of the role of biodiversity conservation in counteracting major obstacles to sustainable development, such as poverty or human population growth, was curiously one-sided. Naess, in a philosophical paper loaded with exclamation marks and bold type, seems to believe that the essential element is an ethical commitment to "the richness and diversity of life forms on earth." Who would disagree? Several authors focus on the role of indigenous peoples and local populations, but mostly to suggest that any change in their activities would be a threat to biodiversity. An opportunity was missed to seek out the views of development organizations working at putting the "sustainable" into development. We are left to meditate Shiva's romantic proposal of Gandhi's spinning wheel as a symbol for "a deeper consideration of the social and ecological context in which technology development takes place."

Although the book does not offer a synthesis of conservation and development, it does contribute to debate and dialogue. The section on "Biotechnological Challenges" probably should have been titled "Biopolitics." Authors discuss such hot topics as intellectual property rights for life forms and the release of genetically modified organisms. In her interpretation of the implications of biodiversity to technology development, for example, Shiva accuses the International Union for the Conservation of Nature of constructing "an interesting value framework" within which "the Third World is responsible for the destruction of its biological wealth, and the North alone has the capacity to conserve it." McNeely responds elsewhere, deploring the "separation of environmental conservation and economic development, often involving the decline of indigenous systems of resource management," and stating that "one of the best ways to build stronger support for conservation is to support indigenous conservation efforts by local people." Exchanges such as these keep the reading interesting.

Recommendations for action form the seventh and final section of the book. Only the executive summary of the recommendations put forth at the conference is included, which is unfortunate. Drafted two years before the Earth Summit, many recommendations strongly foreshadow the Convention on Biological Diversity, which was signed by most countries in 1992 at Rio de Janeiro. They are addressed to policy makers, managers, and researchers. This reviewer noted with satisfaction that heading the list for researchers is the exhortation to "develop standard procedures for the measurement of biodiversity." Further down we are enjoined to use these procedures to "initiate long-term studies on demographic, genetic,and environmental variation." It brings home how little baseline information we really possess to help establish methods for biodiversity conservation.

Soule and Mills write that "until the middle 1970s most of the people in charge of conservation ignored genetics, and most of the people in charge of genetics ignored conservation." Although, presumably, that situation has improved, "environmentalists" and "developmentalists" still don't see eye to eye today. People, whose main interest lies in one domain, find it far too easy to characterize the other as being of peripheral significance. "Conservationists," counting up number of species, may feel that too much is made of the 200 or so species (dixit Heywood) regularly used by human beings, compared to the millions that remain unidentified, poorly studied, and/or in danger of extinction. On the other hand, planners, agriculturalists, and foresters are often frustrated that their sectors are being asked to finance the preservation of species that impacts only marginally, if at all, the alleviation of poverty and famine. *Conservation of Biodiversity for Sustainable Development* may help widen the perspectives of those who haven't realized that a "strictly utilitarian conceptualization of species and genetic diversity is inconsistent with the long-term protection of biodiversity, and the maintenance of genetic resources for the benefit of future generations," as well as those who have not yet accepted that spaces and species will not be conserved properly "while global poverty and inequality are rampant."

Brad Fraleigh, Biodiversity Convention Office,
Environment Canada, Hull, Québec, Canada

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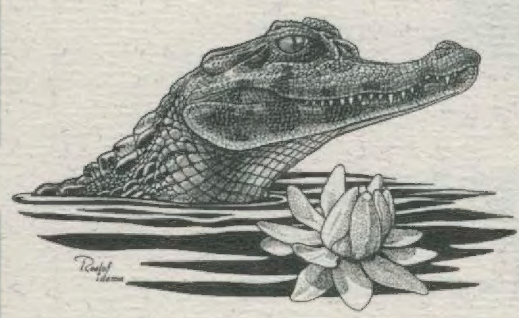

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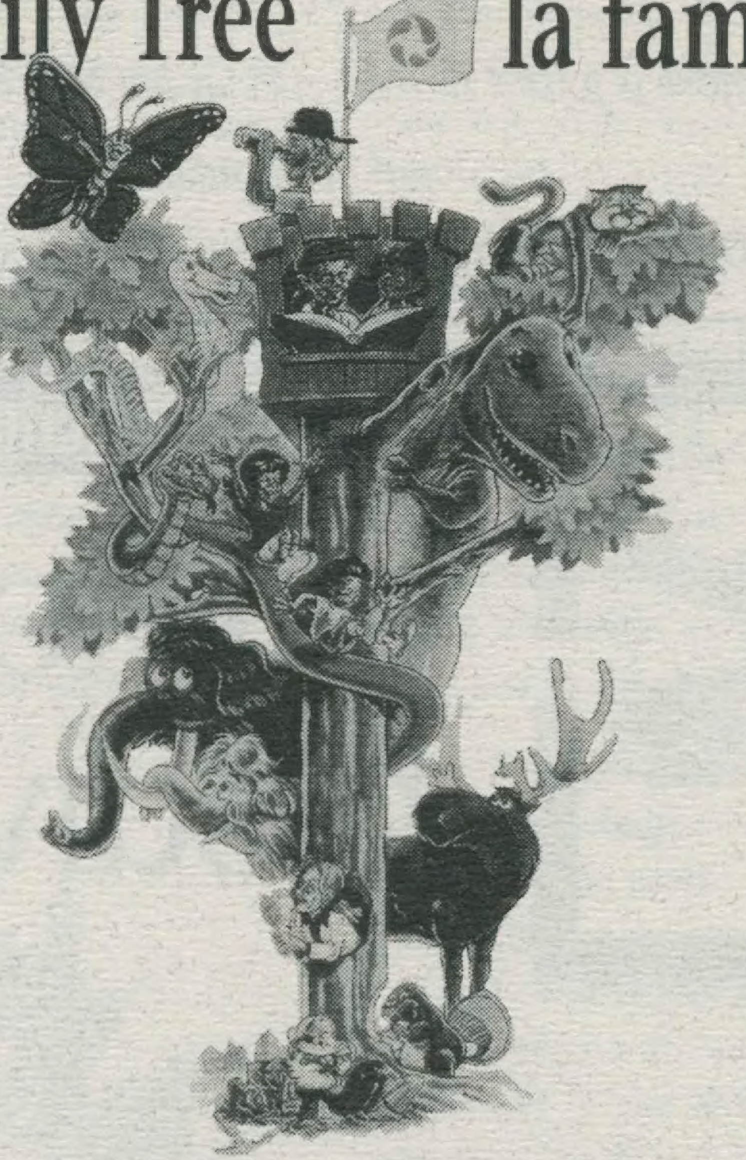

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Environmental Reviews

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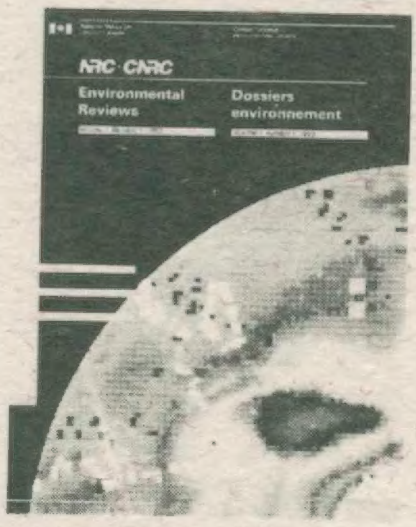
Editor: T.C. Hutchinson



This is a new journal dealing with reviews in the broad area of environmental sciences, with the first volume to be published in 1993. The authorship and scope will be international, with critical reviews being invited as well as submitted. The emphasis will be on the effect and responses of both natural and man-made ecosystems to anthropogenic stress. Specific areas to be covered will include climate change, forest management and harvesting impacts, forest decline, air pollution, stratospheric and tropospheric ozone, UV-B, acid rain, pesticide use and effects, lake acidification, marine pollution, ecology of oil spills, toxic chemicals in aquatic and terrestrial food chains, heavy metals in the environment, ecological impacts of dams, biological control, food chain biomagnification, reclamation of contaminated land, rehabilitation of polluted aquatic systems, impacts of toxicants on nutrient cycling and on microbial pollutions, erosion and agriculture, agroforestry, and specific bioindicators of ecosystem stress.

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Plantanthera leucophaea

Understand, learned one, that there can be no intermediary who understands our region better than we do, or who know us better than we know ourselves. Those who want to learn from us may do so...

Jiminez Turon, a member of the Ye'cuna tribe of Venezuela

Canadian Museum of Nature

Musée canadien de la nature